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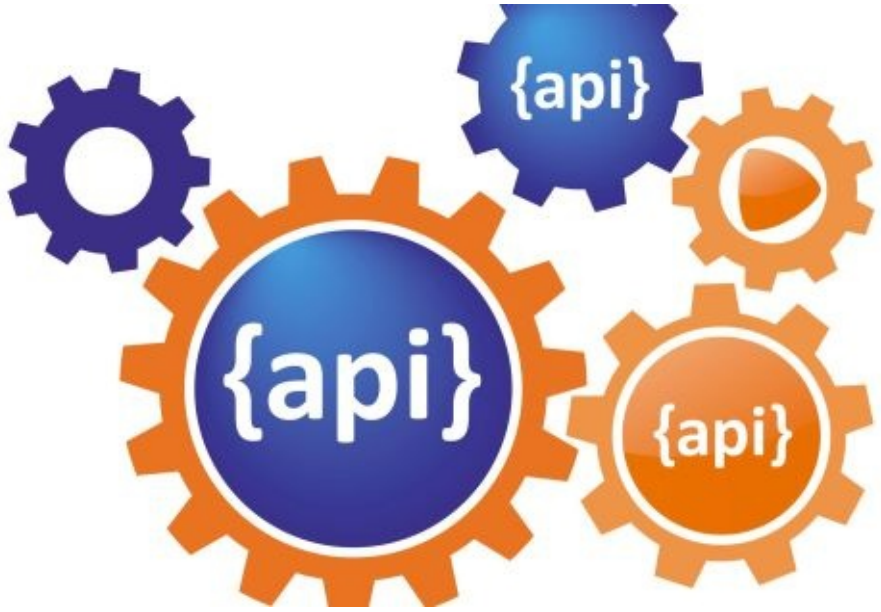

Introduction

Zalando's software architecture centers around decoupled microservices that provide functionality via RESTful APIs with a JSON payload. Small engineering teams own, deploy and operate these microservices in their AWS (team) accounts. Our APIs most purely express what our systems do, and are therefore highly valuable business assets. Designing high-quality, long-lasting APIs has become even more critical for us since we started developing our new open platform strategy, which transforms Zalando from an online shop into an expansive fashion platform. Our strategy emphasizes developing lots of public APIs for our external business partners to use via third-party applications.

With this in mind, we've adopted "API First" as one of our key engineering principles. Microservices development begins with API definition outside the code and ideally involves ample peer-review feedback to achieve high-quality APIs. API First encompasses a set of quality-related standards and fosters a peer review culture including a lightweight review procedure. We encourage our teams to follow them to ensure that our APIs:

- are easy to understand and learn
- are general and abstracted from specific implementation and use cases
- are robust and easy to use
- have a common look and feel
- follow a consistent RESTful style and syntax
- are consistent with other teams' APIs and our global architecture

Ideally, all Zalando APIs will look like the same author created them.

Zalando specific information

The purpose of our "RESTful API guidelines" is to define standards to successfully establish "consistent API look and feel" quality. The API Guild [internal link] drafted and owns this document. Teams are responsible to fulfill these guidelines during API development and are encouraged to contribute to guideline evolution via pull requests.

Note: These guidelines will, to some extent, remain work in progress as our work evolves, but teams can confidently follow and trust them.

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Design Principles

To compare the interface design approaches of SOAP-based web services to those of REST services, the former tend to be centered around operations that are usually use-case specific and specialized. In contrast, REST is all about (business) entities found in the system and exposed as resource endpoints — leading to interfaces that are more broadly usable (here, clients sometimes have to filter out unnecessary information).

API Design Principles

1. We prefer REST-based APIs with JSON payloads
2. We prefer systems to be truly RESTful
3. We strive to build interoperating distributed systems that different teams can evolve in parallel

An important principle for (RESTful) API design and usage is Postel's Law, aka the Robustness Principle (RFC 1122): “Be liberal in what you accept, be conservative in what you send.”

Read the following to gain additional insight on the RESTful service architecture paradigm and general RESTful API design style:

- Fielding Dissertation: Architectural Styles and the Design of Network-Based Software Architectures
- Book: REST in Practice: Hypermedia and Systems Architecture
- Book: Build APIs You Won't Hate
- InfoQ eBook: Web APIs: From Start to Finish
- Lessons-learned blog: Thoughts on RESTful API Design

We apply the RESTful web service principles to all kind of application components, whether they provide functionality via the Internet or via the intranet as larger application elements. We strive to build interoperating distributed systems that different teams can evolve in parallel.

General Guidelines

The titles are marked with the corresponding labels: **Must:**, **Should:**, **Could:**.

Must: Follow API First Principle

As mentioned in the introduction, API First is one of our architecture principles, as per our Architecture Rules of Play. In a nutshell API First has two aspects:

- define APIs outside the code first using a standard specification language
- get early review feedback from peers and client developers

By defining APIs outside the code, we want to facilitate early review feedback and also a development discipline that focus service interface design on...

- profound understanding of the domain and required functionality
- generalized business entities / resources, i.e. avoidance of use case specific APIs
- clear separation of WHAT vs. HOW concerns, i.e. abstraction from implementation aspects — APIs should be stable even if we replace complete service implementation including its underlying technology stack

Moreover, API definitions with standardized specification format also facilitate...

- single source of truth for the API specification; it is a crucial part of a contract between service provider and client users
- infrastructure tooling for API discovery, API GUIs, API documents, automated quality checks

An element of API First are also this API Guidelines and a lightweight API review process [internal link] as to get early review feedback from peers and client developers. Peer review is important for us to get high quality APIs, to enable architectural and design alignment and to supported development of client applications decoupled from service provider engineering life cycle.

It is important to learn, that API First is **not in conflict with the agile development principles** that we love. Service applications should evolve incrementally — and so its APIs. Of course, our API specification will and should evolve iteratively in different cycles, each starting with draft status and early team and peer review feedback.

API may change and profit from implementation concerns and automated testing feedback. API evolution during development life cycle may include breaking changes for not yet productive features and as long as we have aligned the changes with the clients. Hence, API First does *not* mean that you must have 100% domain and requirement understanding and can never produce code before you have defined the complete API and get it confirmed by peer review. On the other hand, API First obviously is in conflict with the practice of publishing API definition and asking for peer review after the service integration or even the service productive operation has started. It is crucial to request and get early feedback — as early as possible, but not before the API changes are comprehensive with focus to the next evolution step and have a certain quality (including API Guideline compliance), already confirmed via team internal reviews.

Must: Provide API Reference Definition using OpenAPI

We use the OpenAPI specification (aka Swagger spec) as standard for our REST API definitions. You may choose YAML or JSON as a format of your OpenAPI API definition file; however, YAML is generally preferred due to its improved readability.

We also call the OpenAPI API definition the "API Reference definition" (or "API definition"); it provides all information needed by an experienced API client developer to use this API.

The OpenAPI API specification file should be subject of version control together with source code management. Services also have to support an endpoint to access the API Reference definition for their external API(s).

Should: Provide User Manual Documentation

In addition to defining the API as OpenAPI Reference Definition, it’s good practice to provide further documentation to improve client developer experience, especially of engineers that are novices in using this API. A helpful API User Manual documentation typically describes the following API aspects:

- API’s scope, purpose and use cases
- concrete usage examples
- architecture context - including figures and sequence flows
- edge cases and possible error situations

The User Manual must be posted online, e.g. via GitHub Enterprise pages, on specific team web servers, or as a Google doc. And don't forget to include a link to this user manual documentation into your OpenAPI definition using the “externalDocs” property.

Must: Write APIs in U.S. English

Security

Must: Secure Endpoints with OAuth 2.0

Every API endpoint needs to be secured using OAuth 2.0. Please refer to the official OpenAPI spec on how to specify security definitions in you API specification or take a look at the following example.

```
securityDefinitions:
  oauth2:
    type: oauth2
    flow: implicit
    authorizationUrl: https://auth.zalando.com/oauth2/access_token?realm=services
    scopes:
      fulfillment-order-service.read: Access right needed to read from the fulfillment order service.
      fulfillment-order-service.write: Access right needed to write to the fulfillment order service.
```

The example defines OAuth2 with implicit flow as security standard used for authentication when accessing endpoints; additionally, there are two API access rights defined via the scopes section for later endpoint authorization usage - please see next section.

Must: Define and Assign Access Rights (Scopes)

Every API needs to define access rights, called scopes here, and every endpoint needs to have at least one scope assigned. Scopes are defined by name and description per API specification, as shown in the previous section. Please refer to the following rules when creating scope names:

```
<api-scope> ::= <api-standard-scope> |           -- should be sufficient for majority of use cases
                <api-resource-specific-scope> |  -- for special security access differentiation use cases
                <api-pseudo-scope>               -- used to explicitly indicate that access is not restricted

<api-standard-scope>          ::= <application-id>.<access-type>
<api-resource-specific-scope> ::= <application-id>.<resource-id>.<access-type>
<api-pseudo-scope>            ::= uid

<application-id> ::= <as defined via STUPS>
<access-type>    ::= read | write          -- might be extended in future
<resource-id>    ::= <free identifier following application-id syntax>
```

APIs should stick to standard scopes by default -- for the majority of use cases, restricting access to specific APIs (with read vs. write differentiation) is sufficient for controlling access for client types like merchant or retailer business partners, customers or operational staff. We want to avoid too many, fine grained scopes increasing governance complexity without real value add. In some situations, where the API serves different types of resources for different owners, resource specific scopes may make sense.

Some examples for standard and resource-specific scopes:

Application ID	Resource ID	Access Type	Example
`fulfillment-order`		`read`	`fulfillment-order.read`
`fulfillment-order`		`write`	`fulfillment-order.write`
`sales-order`	`sales_order`	`read`	`sales-order.sales_order.read`
`sales-order`	`shipment_order`	`read`	`sales-order.shipment_order.read`

After scopes names are defined and the scope is declared in the security definition at the top of an API specification, it should be assigned to each API operation by specifying a `security` requirement like this:

```
paths:
  /sales-orders/{order-number}:
    get:
      summary: Retrieves a sales order
      security:
        - oauth2:
          - sales-order-service.sales_order.read
```

In very rare cases a whole API or some selected endpoints may not require specific access control. However, to make this explicit you should assign the `uid` pseudo access right scope in this case. It is the user id and always available as OAuth2 default scope.

```
paths:
  /public-information:
    get:
      summary: Provides public information about ...
               Accessible by any user; no access rights needed.
      security:
        - oauth2:
          - uid
```

Hint: you need not explicitly define the "Authorization" header; it is a standard header so to say implicitly defined via the security section.

Compatibility

Must: Don’t Break Backward Compatibility

Change APIs, but keep all consumers running. Consumers usually have independent release lifecycles, focus on stability, and avoid changes that do not provide additional value. APIs are service contracts that cannot be broken via unilateral decisions.

There are two techniques to change APIs without breaking them:

- follow rules for compatible extensions
- introduce new API versions and still support older versions

We strongly encourage using compatible API extensions and discourage versioning. With Postel’s Law in mind, here are some rules for providers and consumers that allow us to make compatible changes without versioning:

Should: Prefer Compatible Extensions

Apply the following rules to evolve RESTful APIs in a backward-compatible way:

- Ignore unknown fields in the payload
- Add only optional, never mandatory fields
- Never change the meaning of a field.
- Enum ranges cannot not be extended when used for output parameters — clients may not be prepared to handle it. However, enum ranges can be extended when used for input parameters.
- Enum ranges can be reduced when used as input parameters, only if the server is ready to accept and handle old range values too. Enum values can be reduced when used as output parameters.
- Use `x-extensible-enum`, if range is used for output parameters and likely to be extended with growing functionality. It defines an open list of explicit values and clients must be agnostic to new values (e.g. via casuistic with default behavior).
- Support redirection in case an URL has to change (301 Moved Permanently)

Must: Prepare Clients for Compatible API Extensions (the Robustness Principle)

How to do this:

- Ignore new and unknown fields in the payload (see also Fowler’s “TolerantReader” post)
- Be prepared for new enum values declared with `x-extensible-enum`; provide default behavior for unknown values, if applicable
- Follow the redirect when the server returns an “HTTP 301 Moved Permanently” response code
- Be prepared to handle HTTP status codes not explicitly specified in endpoint definitions! Note also, that status codes are extensible -- default handling is how you would treat the corresponding x00 code (see RFC7231 Section 6)

Must: Always Return JSON Objects As Top-Level Data Structures To Support Extensibility

In a response body, you must always return a JSON objects (and not e.g. an array) as a top level data structure to support future extensibility. JSON objects support compatible extension by additional attributes. This allows you to easily extend your response and e.g. add pagination later, without breaking backwards compatibility.

Should: Used Open-Ended List of Values (x-extensible-enum) Instead of Enumerations

Enumerations are per definition closed sets of values, that are assumed to be complete and not intended for extension. This closed principle of enumerations imposes compatibility issues when an enumeration must be extended. To avoid these issues, we strongly recommend to use an open-ended list of values instead of an enumeration unless:

1. the API has full control of the enumeration values, i.e. the list of values does not depend on any external tool or interface, and
2. the list of value is complete with respect to any thinkable and unthinkable future feature.

To specify an open-ended list of values use the marker `x-extensible-enum` as follows:

```
deliver_methods:
  type: string
  x-extensible-enum:
    - parcel
    - letter
    - email
```

Note: `x-extensible-enum` is not JSON Schema conform but will be ignored by most tools.

Should: Avoid Versioning

When changing your RESTful APIs, do so in a compatible way and avoid generating additional API versions. Multiple versions can significantly complicate understanding, testing, maintaining, evolving, operating and releasing our systems (supplementary reading).

If changing an API can't be done in a compatible way, then proceed in one of these three ways:

- create a new resource (variant) in addition to the old resource variant
- create a new service endpoint — i.e. a new application with a new API (with a new domain name)
- create a new API version supported in parallel with the old API by the same microservice

As we discourage versioning by all means because of the manifold disadvantages, we suggest to only use the first two approaches.

Must: Use Media Type Versioning

When API versioning is unavoidable, you have to design your multi-version RESTful APIs using media type versioning (instead of URI versioning, see below). Media type versioning is less tightly coupled since it supports content negotiation and hence reduces complexity of release management.

Media type versioning: Here, version information and media type are provided together via the HTTP Content-Type header — e.g. application/x.zalando.cart+json;version=2. For incompatible changes, a new media type version for the resource is created. To generate the new representation version, consumer and producer can do content negotiation using the HTTP Content-Type and Accept headers. Note: This versioning only applies to the content schema, not to URI or method semantics.

In this example, a client wants only the new version:

```
Content-Type: application/x.zalando.cart+json;version=2
Accept: application/x.zalando.cart+json;version=2
```

Using header versioning should:

- include versions in request and response headers to increase visibility
- include Content-Type in the Vary header to enable proxy caches to differ between versions

Hint: OpenAPI currently doesn't support content negotiation, though a comment in this issue mentions a workaround (using a fragment identifier that gets stripped off).

Must: Do Not Use URI Versioning

With URI versioning a (major) version number is included in the path, e.g. /v1/customers. The consumer has to wait until the provider has been released and deployed. If the consumer also supports hypermedia links — even in their APIs — to drive workflows (HATEOAS), this quickly becomes complex. So does coordinating version upgrades — especially with hyperlinked service dependencies — when using URL versioning. To avoid this tighter coupling and complexer release management we do not use URI versioning, and go instead with media type versioning and content negotiation (see above).

Should: Provide Version Information in OpenAPI Documentation

Only the documentation, not the API itself, needs version information.

Example:

```
"swagger": "2.0",
"info": {
  "title": "Parcel service API",
  "description": "API for <...>",
  "version": "1.0.0",
    <...>
}
```

During a (possibly) long-running API review phase you need different versions of the API description. These versions may include changes that are incompatible with earlier draft versions. So we apply the following version schema MAJOR.MINOR.DRAFT that increments the...

- MAJOR version, when you make incompatible API changes
- MINOR version, when you add functionality in a backwards-compatible manner
- DRAFT version, when you make changes during the review phase that are not related to production releases

We recommend using the DRAFT version only for unreleased API definitions that are still under review; for example:

```
version 1.4.0  -- current version
version 1.4.1  -- first draft and call for review of API extensions compatible with 1.4.0
version 1.4.2  -- second draft and call for review of API extensions that are still compatible
                  with 1.4.0 but possibly incompatible with 1.4.1
version 1.5.0  -- approved version for implementation and release
version 1.5.1  -- first draft for next review and API change cycle;
                  compatible with 1.4.0 and 1.5.0
```

Hint: This versioning scheme differs in the less strict DRAFT aspect from semantic version information used for released APIs and service applications.

JSON Guidelines

These guidelines provides recommendations for defining JSON data at Zalando. JSON here refers to RFC 7159 (which updates RFC 4627), the “application/json” media type and custom JSON media types defined for APIs. The guidelines clarifies some specific cases to allow Zalando JSON data to have an idiomatic form across teams and services.

Must: Use Consistent Property Names

Must: Property names must be snake_case (and never camelCase).

No established industry standard exists, but many popular Internet companies prefer snake_case: e.g. GitHub, Stack Exchange, Twitter. Others, like Google and Amazon, use both - but not only camelCase. It’s essential to establish a consistent look and feel such that JSON looks as if it came from the same hand.

Must: Property names must be an ASCII subset

Property names are restricted to ASCII encoded strings. The first character must be a letter, an underscore or a dollar sign, and subsequent characters can be a letter, an underscore, a dollar sign, or a number.

Should: Reserved JavaScript keywords should be avoided

Most API content is consumed by non-JavaScript clients today, but for security and sanity reasons, JavaScript (strictly, ECMAScript) keywords are worth avoiding. A list of keywords can be found in the ECMAScript Language Specification.

Should: Array names should be pluralized

To indicate they contain multiple values prefer to pluralize array names. This implies that object names should in turn be singular.

Must: Use Consistent Property Values

Must: Boolean property values must not be null

Schema based JSON properties that are by design booleans must not be presented as nulls. A boolean is essentially a closed enumeration of two values, true and false. If the content has a meaningful null value, strongly prefer to replace the boolean with enumeration of named values or statuses - for example accepted_terms_and_conditions with true or false can be replaced with terms_and_conditions with values yes, no and unknown.

Should: Null values should have their fields removed

Swagger/OpenAPI, which is in common use, doesn't support null field values (it does allow omitting that field completely if it is not marked as required). However that doesn't prevent clients and servers sending and receiving those fields with null values. Also, in some cases null may be a meaningful value - for example, JSON Merge Patch RFC 7382) using null to indicate property deletion.

Should: Empty array values should not be null

Empty array values can unambiguously be represented as the the empty list, `[]`.

Should: Enumerations should be represented as Strings

Strings are a reasonable target for values that are by design enumerations.

Should: Date property values should conform to RFC 3399

Use the date and time formats defined by RFC 3339:

- for "date" use strings matching `date-fullyear "-" date-month "-" date-mday`, for example: `2015-05-28`
- for "date-time" use strings matching `full-date "T" full-time`, for example `2015-05-28T14:07:17Z`

Note that the OpenAPI format "date-time" corresponds to "date-time" in the RFC) and `2015-05-28` for a date (note that the OpenAPI format "date" corresponds to "full-date" in the RFC). Both are specific profiles, a subset of the international standard ISO 8601.

A zone offset may be used (both, in request and responses) -- this is simply defined by the standards. However, we encourage restricting dates to UTC and without offsets. For example `2015-05-28T14:07:17Z` rather than `2015-05-28T14:07:17+00:00`. From experience we have learned that zone offsets are not easy to understand and often not correctly handled. Note also that zone offsets are different from local times that might be including daylight saving time. Localization of dates should be done by the services that provide user interfaces, if required.

When it comes to storage, all dates should be consistently stored in UTC without a zone offset. Localization should be done locally by the services that provide user interfaces, if required.

Sometimes it can seem data is naturally represented using numerical timestamps, but this can introduce interpretation issues with precision - for example whether to represent a timestamp as 1460062925, 1460062925000 or 1460062925.000. Date strings, though more verbose and requiring more effort to parse, avoid this ambiguity.

Could: Time durations and intervals could conform to ISO 8601

Schema based JSON properties that are by design durations and intervals could be strings formatted as recommended by ISO 8601 (Appendix A of RFC 3399 contains a grammar for durations).

Could: Standards could be used for Language, Country and Currency

- ISO 3166-1-alpha2 country
  - (It's "GB", not "UK", even though "UK" has seen some use at Zalando)
- ISO 639-1 language code
  - BCP-47 (based on ISO 639-1) for language variants
- ISO 4217 currency codes

API Naming

Must: Use lowercase separate words with hyphens for Path Segments

Example:

```
/shipment-orders/{shipment-order-id}
```

This applies to concrete path segments and not the names of path parameters. For example `{shipment_order_id}` would be ok as a path parameter.

Must: Use snake_case (never camelCase) for Query Parameters

Examples:

```
customer_number, order_id, billing_address
```

Must: Use Hyphenated HTTP Headers

Should: Prefer Hyphenated-Pascal-Case for HTTP header Fields

This is for consistency in your documentation (most other headers follow this convention). Avoid camelCase (without hyphens). Exceptions are common abbreviations like “ID.”

Examples:

```
Accept-Encoding
Apply-To-Redirect-Ref
Disposition-Notification-Options
Original-Message-ID
```

See also: HTTP Headers are case-insensitive (RFC 7230).

Could: Use Standardized Headers

Use this list and mention its support in your OpenAPI definition.

Must: Pluralize Resource Names

Usually, a collection of resource instances is provided (at least API should be ready here). The special case of a resource singleton is a collection with cardinality 1.

Could: Use /api as first Path Segment

In most cases, all resources provided by a service are part of the public API, and therefore should be made available under the root “/” base path. If the service should also support non-public, internal APIs — for specific operational support functions, for example — add “/api” as base path to clearly separate public and non-public API resources.

Must: Avoid Trailing Slashes

The trailing slash must not have specific semantics. Resource paths must deliver the same results whether they have the trailing slash or not.

Could: Use Conventional Query Strings

If you provide query support for sorting, pagination, filtering functions or other actions, use the following standardized naming conventions:

- `q` — default query parameter (e.g. used by browser tab completion); should have an entity specific alias, like sku
- `limit` — to restrict the number of entries. See Pagination section below. Hint: You can use size as an alternate query string.
- `cursor` — key-based page start. See Pagination section below.
- `offset` — numeric offset page start. See Pagination section below. Hint: In combination with limit, you can use page as an alternative to offset.
- `sort` — comma-separated list of fields to sort. To indicate sorting direction, fields my prefixed with + (ascending) or - (descending, default), e.g. /sales-orders?sort=+id
- `fields` — to retrieve a subset of fields. See *Support Filtering of Resource Fields* below.
- `embed` — to expand embedded entities (ie.: inside of an article entity, expand silhouette code into the silhouette object). Implementing “expand” correctly is difficult, so do it with care. See *Embedding resources* for more details.

Resources

Must: Avoid Actions — Think About Resources

REST is all about your resources, so consider the domain entities that take part in web service interaction, and aim to model your API around these using the standard HTTP methods as operation indicators. For instance, if an application has to lock articles explicitly so that only one user may edit them, create an article lock with PUT or POST instead of using a lock action.

Request:

```
PUT /article-locks/{article-id}
```

The added benefit is that you already have a service for browsing and filtering article locks.

Should: Define *useful* resources

As a rule of thumb resources should be defined to cover 90% of all its client's use cases. A *useful* resource should contain as much information as necessary, but as little as possible. A great way to support the last 10% is to allow clients to specify their needs for more/less information by supporting filtering and embedding.

Must: Keep URLs Verb-Free

The API describes resources, so the only place where actions should appear is in the HTTP methods. In URLs, use only nouns.

Must: Use Domain-Specific Resource Names

API resources represent elements of the application’s domain model. Using domain-specific nomenclature for resource names helps developers to understand the functionality and basic semantics of your resources. It also reduces the need for further documentation outside the API definition. For example, “sales-order-items” is superior to “order-items” in that it clearly indicates which business object it represents. Along these lines, “items” is too general.

Must: Identify resources and Sub-Resources via Path Segments

Basic URL structure:

```
/{resources}/[resource-id]/{sub-resources}/[sub-resource-id]
```

Examples:

```
/carts/1681e6b88ec1/items
/carts/1681e6b88ec1/items/1
```

Could: Consider Using (Non-) Nested URLs

If a sub-resource is only accessible via its parent resource and may not exists without parent resource, consider using a nested URL structure, for instance:

```
/carts/1681e6b88ec1/cart-items/1
```

However, if the resource can be accessed directly via its unique id, then the API should expose it as a top-level resource. For example, customer is a collection for sales orders; however, sales orders have globally unique id and some services may choose to access the orders directly, for instance:

```
/customers/1681e6b88ec1
/sales-orders/5273gh3k525a
```

Should: Limit number of Resources

To keep maintenance and service evolution manageable, we should follow "functional segmentation" and "separation of concern" design principles and do not mix different business functionalities in same API definition. In this sense the number of resources exposed via API should be limited - our experience is that a typical range of resources for a well-designed API is between 4 and 8. There may be exceptions with more complex business domains that require more resources, but you should first check if you can split them into separate subdomains with distinct APIs.

Should: Limit number of Sub-Resource Levels

There are main resources (with root url paths) and sub-resources (or “nested” resources with non-root urls paths). Use sub-resources if their life cycle is (loosely) coupled to the main resource, i.e. the main resource works as collection resource of the subresource entities. You should use <= 3 sub-resource (nesting) levels -- more levels increase API complexity and url path length. (Remember, some popular web browsers do not support URLs of more than 2000 characters)

HTTP

Must: Use HTTP Methods Correctly

Be compliant with the standardized HTTP method semantics summarized as follows:

GET

GET requests are used to read a single resource or query set of resources.

- GET requests for individual resources will usually generate a 404 if the resource does not exist
- GET requests for collection resources may return either 200 (if the listing is empty) or 404 (if the list is missing)
- GET requests must NOT have request body payload

Note: GET requests on collection resources should provide a sufficient filter mechanism as well as pagination.

PUT

PUT requests are used to create or update single resources or an entire collection resources. The semantic is best described as »*please put the enclosed representation at the resource mentioned by the URL*«.

- PUT requests are usually applied to single resources, and not to collection resources, as this would imply replacing the entire collection
- PUT requests are usually robust against non-existence of resources by implicitly creating before updating
- on successful PUT requests, the server will replace the entire resource addressed by the URL with the representation passed in the payload
- successful PUT requests will usually generate 200 or 204 (if the resource was updated - with or without actual content returned), and 201 (if the resource was created)

Note: Resource IDs with respect to PUT requests are maintained by the client and passed as a URL path segment. Putting the same resource twice is required to be idempotent and to result in the same single resource instance. If PUT is applied for creating a resource, only URIs should be allowed as resource IDs. If URIs are not available POST should be preferred.

POST

POST requests are idiomatically used to create single resources on a collection resource endpoint, but other semantics on single resources endpoint are equally possible. The semantic for collection endpoints is best described as »*please add the enclosed representation to the collection resource identified by the URL*«. The semantic for single resource endpoints is best described as »*please execute the given well specified request on the collection resource identified by the URL*«.

- POST request should only be applied to collection resources, and normally not on single resource, as this has an undefined semantic
- on successful POST requests, the server will create one or multiple new resources and provide their URI/URLs in the response
- successful POST requests will usually generate 200 (if resources have been updated), 201 (if resources have been created), and 202 (if the request was accepted but has not been finished yet)

More generally: POST should be used for scenarios that cannot be covered by the other methods sufficiently. For instance, GET with complex (e.g. SQL like structured) query that needs to be passed as request body payload because of the URL-length constraint. In such cases, make sure to document the fact that POST is used as a workaround.

Note: Resource IDs with respect to POST requests are created and maintained by server and returned with response payload. Posting the same resource twice is by itself **not** required to be idempotent and may result in multiple resource instances. Anyhow, if external URIs are present that can be used to identify duplicate requests, it is best practice to implement POST in an idempotent way.

PATCH

PATCH request are only used for partial update of single resources, i.e. where only a specific subset of resource fields should be replaced. The semantic is best described as »*please change the resource identified by the URL according to my change request*«. The semantic of the change request is not defined in the HTTP standard and must be described in the API specification by using suitable media types.

- PATCH requests are usually applied to single resources, and not on collection resources, as this would imply patching on the entire collection
- PATCH requests are usually not robust against non-existence of resource instances
- on successful PATCH requests, the server will update parts of the resource addressed by the URL as defined by the change request in the payload
- successful PATCH requests will usually generate 200 or 204 (if resources have been updated
  - with or without updated content returned)

Note: since implementing PATCH correctly is a bit tricky, we strongly suggest to choose one and only one of the following patterns per endpoint, unless forced by a backwards compatible change. In preference order:

1. use PUT with complete objects to update a resource as long as feasible (i.e. do not use PATCH at all).
2. use PATCH with partial objects to only update parts of a resource, when ever possible. (This is basically JSON Merge Patch, a specialized media type `application/merge-patch+json` that is a partial resource representation.)
3. use PATCH with JSON Patch, a specialized media type `application/json-patch+json` that includes instructions on how to change the resource.
4. use POST (with a proper description of what is happening) instead of PATCH if the request does not modify the resource in a way defined by the semantics of the media type.

In practice JSON Merge Patch quickly turns out to be too limited, especially when trying to update single objects in large collections (as part of the resource). In this cases JSON Patch can shown its full power while still showing readable patch requests (see also).

DELETE

DELETE request are used to delete resources. The semantic is best described as »*please delete the resource identified by the URL*«.

- DELETE requests are usually applied to single resources, not on collection resources, as this would imply deleting the entire collection
- successful DELETE request will usually generate 200 (if the deleted resource is returned) or 204 (if no content is returned)
- failed DELETE request will usually generate 404 (if the resource cannot be found) or 410 (if the resource was already deleted before)

HEAD

HEAD requests are used retrieve to header information of single resources and resource collections.

- HEAD has exactly the same semantics as GET, but returns headers only, no body.

OPTIONS

OPTIONS are used to inspect the available operations (HTTP methods) of a given endpoint.

- OPTIONS requests usually either return a comma separated list of methods (provided by an `Allow:` -Header) or as a structured list of link templates

Note: OPTIONS is rarely implemented, though it could be used to self-describe the full functionality of a resource.

Must: Fulfill Safeness and Idempotency Properties

An operation can be...

- idempotent, i.e. operation will produce the same results if executed once or multiple times (note: this does not necessarily mean returning the same status code)
- safe, i.e. must not have side effects such as state changes

Method implementations must fulfill the following basic properties:

HTTP method	safe	idempotent
OPTIONS	Yes	Yes
HEAD	Yes	Yes
GET	Yes	Yes
PUT	No	Yes
POST	No	No
DELETE	No	Yes
PATCH	No	No

Please see also Best Practices [internal link] for further hints on how to support the different HTTP methods on resources.

Must: Use Meaningful HTTP Status Codes

Success Codes

Code	Meaning	Methods
200	OK - this is the standard success response	All
201	Created - Returned on successful entity creation. You are free to return either an empty response or the created resource in conjunction with the Content-Location header. (More details found in the Common Headers section.) *Always* set the Location header.	POST, PUT
202	Accepted - The request was successful and will be processed asynchronously.	POST, PUT, DELETE, PATCH
204	No content - There is no response body	PUT, DELETE

Redirection Codes

Code	Meaning	Methods
301	Moved Permanently - This and all future requests should be directed to the given URI.	All
303	See Other - The response to the request can be found under another URI using a GET method.	PATCH, POST, PUT, DELETE
304	Not Modified - resource has not been modified since the date or version passed via request headers If-Modified-Since or If-None-Match.	GET

Client Side Error Codes

Code	Meaning	Methods
400	Bad request - generic / unknown error	All
401	Unauthorized - the users must log in (this often means “Unauthenticated”)	All
403	Forbidden - the user is not authorized to use this resource	All
404	Not found - the resource is not found	All
405	Method Not Allowed - the method is not supported, see OPTIONS	All
406	Not Acceptable - resource can only generate content not acceptable according to the Accept headers sent in the request	All
408	Request timeout - the server times out waiting for the resource	All
409	Conflict - request cannot be completed due to conflict, e.g. when two clients try to create the same resource or if there are concurrent, conflicting updates	PUT, DELETE, PATCH
410	Gone - resource does not exist any longer, e.g. when accessing a resource that has intentionally been deleted	All
412	Precondition Failed - returned for conditional requests, e.g. If-Match if the condition failed. Used for optimistic locking.	PUT, DELETE, PATCH
415	Unsupported Media Type - e.g. clients sends request body without content type	PUT, DELETE, PATCH
423	Locked - Pessimistic locking, e.g. processing states	PUT, DELETE, PATCH
428	Precondition Required - server requires the request to be conditional (e.g. to make sure that the “lost update problem” is avoided).	All
429	Too many requests - the client does not consider rate limiting and sent too many requests. See "Use 429 with Headers for Rate Limits".	All

Server Side Error Codes:

Code	Meaning	Methods
500	Internal Server Error - a generic error indication for an unexpected server execution problem (here, client retry may be senseful)	All
501	Not Implemented - server cannot fulfill the request (usually implies future availability, e.g. new feature).	All
503	Service Unavailable - server is (temporarily) not available (e.g. due to overload) -- client retry may be senseful.	All

All error codes can be found in RFC7231 and Wikipedia or via https://httpstatuses.com/.

Must: Provide Error Documentation

APIs should define the functional, business view and abstract from implementation aspects. Errors become a key element providing context and visibility into how to use an API. The error object should be extended by an application-specific error identifier if and only if the HTTP status code is not specific enough to convey the domain-specific error semantic. For this reason, we use a standardized error return object definition — see *Use Common Error Return Objects*.

The OpenAPI specification shall include definitions for error descriptions that will be returned; they are part of the interface definition and provide important information for service clients to handle exceptional situations and support troubleshooting. You should also think about a troubleshooting board — it is part of the associated online API documentation, provides information and handling guidance on application-specific errors and is referenced via links of the API definition. This can reduce service support tasks and contribute to service client and provider performance.

Service providers should differentiate between technical and functional errors. In most cases it's not useful to document technical errors that are not in control of the service provider unless the status code convey application-specific semantics. The list of status code that can be omitted from API specifications includes but is not limited to:

- `401 Unauthorized`
- `403 Forbidden`
- `404 Not Found` unless it has some additional semantics
- `405 Method Not Allowed`
- `406 Not Acceptable`
- `408 Request Timeout`
- `413 Payload Too Large`
- `414 URI Too Long`
- `415 Unsupported Media Type`
- `500 Internal Server Error`
- `502 Bad Gateway`
- `503 Service Unavailable`
- `504 Gateway Timeout`

Even though they might not be documented - they may very much occur in production, so clients should be prepared for unexpected response codes, and in case of doubt handle them like they would handle the corresponding x00 code. Adding new response codes (specially error responses) should be considered a compatible API evolution.

Functional errors on the other hand, that convey domain-specific semantics, must be documented and are strongly encouraged to be expressed with *Problem types*.

Must: Use 429 with Headers for Rate Limits

APIs that wish to manage the request rate of clients must use the '429 Too Many Requests' response code if the client exceeded the request rate and therefore the request can't be fulfilled. Such responses must also contain header information providing further details to the client. There are two approaches a service can take for header information:

- Return a 'Retry-After' header indicating how long the client ought to wait before making a follow-up request. The Retry-After header can contain a HTTP date value to retry after or the number of seconds to delay. Either is acceptable but APIs should prefer to use a delay in seconds.
- Return a trio of 'X-RateLimit' headers. These headers (described below) allow a server to express a service level in the form of a number of allowing requests within a given window of time and when the window is reset.

The 'X-RateLimit' headers are:

- `X-RateLimit-Limit` : The maximum number of requests that the client is allowed to make in this window.
- `X-RateLimit-Remaining` : The number of requests allowed in the current window.
- `X-RateLimit-Reset` : The relative time in seconds when the rate limit window will be reset.

The reason to allow both approaches is that APIs can have different needs. Retry-After is often sufficient for general load handling and request throttling scenarios and notably, does not strictly require the concept of a calling entity such as a tenant or named account. In turn this allows resource owners to minimise the amount of state they have to carry with respect to client requests. The 'X-RateLimit' headers are suitable for scenarios where clients are associated with pre-existing account or tenancy structures. 'X-RateLimit' headers are generally returned on every request and not just on a 429, which implies the service implementing the API is carrying sufficient state to track the number of requests made within a given window for each named entity.

Performance

Should: Reduce Bandwidth Needs and Improve Responsiveness

APIs should support techniques for reducing bandwidth based on client needs. This holds for APIs that (might) have high payloads and/or are used in high-traffic scenarios like the public Internet and telecommunication networks. Typical examples are APIs used by mobile web app clients with (often) less bandwidth connectivity. (Zalando is a 'Mobile First' company, so be mindful of this point.)

Common techniques include:

- gzip compression
- querying field filters to retrieve a subset of resource attributes (see *Support Filtering of Resource Fields* below)
- paginate lists of data items (see *Pagination* below)
- `ETag` (and If-[None-]Match) headers to avoid refetch of unchanged resources
- pagination for incremental access of larger (result) lists

Each of these items is described in greater detail below.

Should: Use gzip Compression

Compress the payload of your API's responses with gzip, unless there's a good reason not to — for example, you are serving so many requests that the time to compress becomes a bottleneck. This helps to transport data faster over the network (fewer bytes) and makes frontends respond faster.

Though gzip compression might be the default choice for server payload, the server should also support payload without compression and its client control via Accept-Encoding request header -- see also RFC 7231 Section 5.3.4. The server should indicate used gzip compression via the Content-Encoding header.

Should: Support Filtering of Resource Fields

Depending on your use case and payload size, you can significantly reduce network bandwidth need by supporting filtering of returned entity fields. Here, the client can determine the subset of fields he wants to receive via the fields query parameter — example see Google AppEngine API's partial response:

Unfiltered

```
GET http://api.example.org/resources/123 HTTP/1.1

HTTP/1.1 200 OK
Content-Type: application/x.person+json

{
  "id": "cddd5e44-dae0-11e5-8c01-63ed66ab2da5",
  "name": "John Doe",
  "address": "1600 Pennsylvania Avenue Northwest, Washington, DC, United States",
  "birthday": "1984-09-13",
  "partner": {
    "id": "1fb43648-dae1-11e5-aa01-1fbc3abb1cd0",
    "name": "Jane Doe",
    "address": "1600 Pennsylvania Avenue Northwest, Washington, DC, United States",
    "birthday": "1988-04-07"
  }
}
```

Filtered

```
GET http://api.example.org/resources/123?fields=(name,partner(name)) HTTP/1.1

HTTP/1.1 200 OK
Content-Type: application/x.person+json;fields=(name,partner(name))

{
  "name": "John Doe",
  "partner": {
    "name": "Jane Doe"
  }
}
```

The approach we recommend for field filtering is a Zalando Github project, json-fields. It defines a formal grammar for the ANTLR parser generator and provides a ready-to use library for Java / Jackson based projects (Maven link). Teams that use other JSON serializers are encouraged to contribute to the open source project and create their own parser / framework based on this grammar.

Other approaches we have considered are JSONPath or GraphQL. While they have advantages, neither of them can easily be plugged into an existing serialization process, so they require an additional, manual serialization process, whereas the above solution addresses our main filter use cases and can easily be introduced with a minimum of effort.

Hint: OpenAPI doesn't allow you to formally specify whether depending on a given parameter will return different parts of the specified result schema. Explain this in English in the parameter description.

Could: Support the ETag Header

If a resource changes, the contents of the `ETag` header must also change. Combined with the `If-Match` and `If-None-Match` headers, the `ETag` header allows caching of entities.

Its possible contents:

- the entity's version number
- hash of the response body
- hash of the entity's last modified field

Also see *Allow Embedding of Complex Sub-Resources* below as contribution to performance optimization to avoid multiple requests for sub-resources.

Should: Allow Optional Embedding of Sub-Resources

Embedding related resources (also know as *Resource expansion*) is a great way to reduce the number of requests. In cases where clients know upfront that they need some related resources they can instruct the server to prefetch that data eagerly. Whether this is optimized on the server, e.g. a database join, or done in a generic way, e.g. an HTTP proxy that transparently embeds resources, is up to the implementation.

See *Conventional Query Strings* for naming. Please use json-fields library, already mentioned above for filtering, when it comes to an embedding query syntax.

Embedding a sub-resource can possibly look like this where an order resource has its order items as sub-resource (/order/{orderId}/items):

```
GET /order/123?embed=(items) HTTP/1.1

{
  "id": "123",
  "_embedded": {
    "items": [
      {
        "position": 1,
        "sku": "1234-ABCD-7890",
        "price": {
          "amount": 71.99,
          "currency": "EUR"
        }
      }
    ]
  }
}
```

Pagination

Must: Support Pagination

Access to lists of data items must support pagination for best client side batch processing and iteration experience. This holds true for all lists that are (potentially) larger than just a few hundred entries.

There are two page iteration techniques:

- Offset/Limit-based pagination: numeric offset identifies the first page entry
- Cursor-based — aka key-based — pagination: a unique key element identifies the first page entry (see also Facebook's guide)

The technical conception of pagination should also consider user experience related issues. As mentioned in this article, jumping to a specific page is far less used than navigation via next/previous page links. This favours cursor-based over offset-based pagination.

Should: Prefer Cursor-Based Pagination, Avoid Offset-Based Pagination

Cursor-based pagination is usually better and more efficient when compared to offset-based pagination. Especially when it comes to high-data volumes and / or storage in NoSQL databases.

Before choosing cursor-based pagination, consider the following trade-offs:

- Usability/framework support:
  - Offset / limit based pagination is more known than cursor-based pagination, so it has more framework support and is easier to use for API clients
- Use case: Jump to a certain page
  - If jumping to a particular page in a range (e.g., 51 of 100) is really a required use case, cursor-based navigation is not feasible
- Variability of data may lead to anomalies in result pages
  - Offset-based pagination may create duplicates or lead to missing entries if rows are inserted or deleted between two subsequent paging requests.
  - When using cursor-based pagination, paging cannot continue when the cursor entry has been deleted while fetching two pages
- Performance considerations - efficient server-side processing using offset-based pagination is hardly feasible for:
  - Higher data list volumes, especially if they do not reside in the database's main memory
  - Sharded or NoSQL databases
- Cursor-based navigation may not work if you need the total count of results and / or backward iteration support

Further reading:

- Twitter
- Use the Index, Luke
- Paging in PostgreSQL

Could: Use Pagination Links Where Applicable

- Set links to provide information to the client about subsequent paging options.

For example:

```
HTTP/1.1 200 OK
Content-Type: application/x.zalando.products+json

{
  "_links": {
    "next": {
      "href": "http://catalog-service.zalando.net/products?offset=15&limit=5"
    },
    "prev": {
      "href": "http://catalog-service.zalando.net/products?offset=5&limit=5"
    }
  },
  "total_count": 42,
  "products": [
    {"id": "7e4ab218-1772-11e6-892c-836df3feeaee"},
    {"id": "9469725a-1772-11e6-83c2-ab22ac368913"},
    {"id": "a3625d80-1772-11e6-9213-d3a20f9e6bf4"},
    {"id": "a802f070-1772-11e6-a772-c3020d55eb5f"},
    {"id": "adb407ac-1772-11e6-b255-078fb28ff55b"}
  ]
}
```

Possible relations: `next`, `prev`, `last`, `first`.

Previous editions of the guidelines documented the `X-Total-Count` header to send back the total count of entities in conjunction with the `Link` header, which has since been deprecated. Instead when returning an object structure, the count can be added as a JSON property, and this is the preferred way to return count (or other result level) information.

The `X-Total-Count` is applicable in these cases:

- The API design is still using the `Link` header.
- The API is returning a non-JSON response media type, and isn't able to carry the information.
- The JSON response is an array and not an object.

You should avoid providing a total count in your API unless there's a clear need to do so. Very often, there are systems and performance implications to supporting full counts, especially as datasets grow and requests become complex queries or filters that drive full scans (e.g., your database might need to look at all candidate items to count them). While this is an implementation detail relative to the API, it's important to consider your ability to support serving counts over the life of a service.

Hypermedia

Must: Use REST Maturity Level 2

We strive for a good implementation of REST Maturity Level 2 as it enables us to build resource-oriented APIs that make full use of HTTP verbs and status codes. You can see this expressed by many rules throughout these guidelines, e.g.:

- Avoid Actions — Think About Resources
- Keep URLs Verb-Free
- Use HTTP Methods Correctly
- Use Meaningful HTTP Status Codes

Although this is not HATEOAS, it should not prevent you from designing proper link relationships in your APIs as stated in rules below.

Could: Use REST Maturity Level 3 - HATEOAS

We do not generally recommend to implement REST Maturity Level 3. HATEOAS comes with additional API complexity without real value in our SOA context where client and server interact via REST APIs and provide complex business functions as part of our e-commerce platform.

Our major concerns regarding the promised advantages of HATEOAS (see also RESTistential Crisis over Hypermedia APIs, Why I Hate HATEOAS and others):

- We follow API First principle with APIs explicitly defined outside the code with standard specification language. HATEOAS does not really add value for SOA client engineers in terms of API self-descriptiveness: a client anyway finds necessary links and description how to use methods on endpoints depending on its state in the API definition.
- Generic HATEOAS clients which need no prior knowledge about APIs and explore API capabilities based on hypermedia information provided, is a theoretical concept that we haven't seen working in practise and does not fit to our SOA set-up. The OpenAPI description format (and tooling based on OpenAPI) doesn't provide sufficient support for HATEOAS either.
- In practice relevant HATEOAS approximations (e.g. following specifications like HAL or JSON API) support API navigation by abstracting from URL endpoint and HTTP method aspects via link types. So, Hypermedia does not prevent clients from required manual changes when domain model changes over time.
- Hypermedia make sense for humans, less for SOA machine clients. We would expect use cases where it may provide value more likely in the frontend and human facing service domain.
- Hypermedia does not prevent API clients to implement shortcuts and directly target resources without 'discovering' them

However, we do not forbid HATEOAS; you could use it, if you checked its limitations and still see clear value for your usage scenario that justifies its additional complexity. If you use HATEOAS please share experience and present your findings in the API Guild [internal link].

Must: Use a well-defined subset of HAL

Links to other resources must be defined exclusively using HAL and preferably using standard link relations.

Clients and Servers are required to support `_links` with its `href` and `rel` attributes, not only at the root level but also in nested objects. To reduce the effort needed by clients to process hypertext data from servers it's not recommended to serve data with CURIEs, URI templates or embedded resources. Nor is it required to support the HAL media type `application/hal+json`. The following snippet specifies the HAL link structure in JSONSchema:

```
Link:
  type: object
  properties:
    href:
      type: string
      format: uri
      example: https://api.example.com/sales-orders/10101058747628
  required:
    - href
Links:
  type: object
  description: |
    Values can be either a single Link or an array of Links
    See https://docs.pennybags.zalan.do/ for more.
  additionalProperties:
    # keys are link relations
    type: array
    items:
      $ref: '#/definitions/Link'
  example:
    'self':
      - href: https://api.example.com/sales-orders/10101058747628
```

We opted for this subset of HAL after conducting a comparison of different hypermedia formats based on properties like:

- Simplicity: resource link syntax and concepts are easy to understand and interpret for API clients.
- Compatibility: introducing and adding links to resources is not breaking existing API clients.
- Adoption: use in open-source libraries and tools as well as other companies
- Docs: degree of good documentation

Standard	Simplicity	Compatibility	Adoption	Primary Focus	Docs
HAL Subset	✓	✓	✓	Links and relationships	✓
HAL	✗	✓	✓	Links and relationships	✓
JSON API	✗	✗	✓	Response format	✓
JSON-LD	✗	✓	?	Link data	?
Siren	✗	✗	✗	Entities and navigation	✗
Collection+JSON	✗	✗	✗	Collections and queries	✓

We define HAL links to be extensible, i.e. to contain additional properties if needed. For consistency extensions should reuse attributes from the `Link` header.

Interesting articles for comparisons of different hypermedia formats:

- Kevin Sookocheff's On choosing a hypermedia type for your API
- Mike Stowe's API Best Practices: Hypermedia

Must: Do Not Use Link Headers with JSON entities

We don't allow the use of the `Link` Header defined by RFC 5988 in conjunction with JSON media types, and favor HAL instead. The primary reason is to have a consistent place for links as well as the better support for links in JSON payloads compared to the uncommon link header syntax.

Could: Use Custom Link Relations

You should consider using a custom link relation if and only if standard link relations are not sufficient to express a relation. Related or even embedded (sub-) resources should be linked via “meta link attributes” within the response payload; use the following HAL compliant syntax:

```
{
  ...
  “_links”: {
    “my-relation”: {
      “href”: “https://service.team.zalan.do/my-entities/123”
    }
  }
}
```

In earlier versions of this rule we proposed URIs but dropped that in favor of readability. Since link relations are properties in the `_links` object you should define and describe them individually in the API specification.

Data Formats

Must: Use JSON as the Body Payload

JSON-encode the body payload. The JSON payload must follow RFC-7159 by having (if possible) a serialized object as the top-level structure, since it would allow for future extension. This also applies for collection resources where one naturally would assume an array. See the pagination section for an example.

Could: Use other Media Types than JSON

If for given use case JSON does not make sense, for instance when providing attachments in form of PDFs, you should use another, more sufficient media type. But only do this if you can not transfer the information in JSON.

Must: Use Standard Date and Time Formats

JSON Payload

Read more about date and time format in Json Guideline.

HTTP headers

Http headers including the proprietary headers. Use the HTTP date format defined in RFC 7231.

Could: Use Standards for Country, Language and Currency Codes

Use the following standard formats for country, language and currency codes:

- ISO 3166-1-alpha2 country codes
  - (It is “GB”, not “UK”, even though “UK” has seen some use at Zalando)
- ISO 639-1 language code
  - BCP-47 (based on ISO 639-1) for language variants
- ISO 4217 currency codes

Could: Use Application-Specific Content Types

For instance, `application/x.zalando.article+json` . For complex types, it’s better to have a specific content type. For simple use cases this isn’t necessary. We can attach version info to media type names and support content negotiation to get different representations, e.g. `application/x.zalando.article+json;version=2` .

Common Data Objects

Definitions of data objects that are good candidates for wider usage:

Should: Use a Common Money Object

Use the following common money structure:

```
Money:
  type: object
  properties:
    amount:
      type: number
      format: decimal
      example: 99.95
    currency:
      type: string
      format: iso-4217
      example: EUR
  required:
    - amount
    - currency
```

Make sure that you don't convert the "amount" field to `float` / `double` types when implementing this interface in a specific language or when doing calculations. Otherwise, you might lose precision. Instead, use exact formats like Java's `BigDecimal`. See Stack Overflow for more info.

Some JSON parsers (NodeJS's, for example) convert numbers to floats by default. After discussing the pros and cons, we've decided on "decimal" as our amount format. It is not a standard OpenAPI format, but should help us to avoid parsing numbers as float / doubles.

Should: Use Common Address Fields

Address structures play a role in different functional and use-case contexts, including country variances. The address structure below should be sufficient for most of our business-related use cases. Use it in your APIs — and compatible extend it if necessary for your API concerns:

```
address:
    description:
      a common address structure adequate for many use cases
    type: object
    properties:
      salutation:
        type: string
        description: |
          A salutation and/or title which may be used for personal contacts. Hint: not to be confused with the gender i
        example: Mr
      first_name:
        type: string
        description: given name(s) or first name(s) of a person; may also include the middle names
        example: Hans Dieter
      last_name:
        type: string
        description: family name(s) or surname(s) of a person
        example: Mustermann
      business_name:
        type: string
        description: company name of the business organization
        example: Consulting Services GmbH
      street:
        type: string
        description: full street address including house number and street name
        example: Schönhauser Allee 103
      additional:
        type: string
        description: further details like suite, apartment number, etc.
        example: 2. Hinterhof rechts
      city:
        type: string
        description: name of the city
        example: Berlin
      zip:
        type: string
        description: Zip code or postal code
        example: 14265
      country_code:
        type: string
        format: iso-3166-1-alpha-2
        example: DE
    required:
      - first_name
      - last_name
      - street
      - city
      - zip
      - country_code
```

Must: Use Problem JSON

RFC 7807 defines the media type `application/problem+json`. Operations should return that (together with a suitable status code) when any problem occurred during processing and you can give more details than the status code itself can supply, whether it be caused by the client or the server (i.e. both for 4xx or 5xx errors).

A previous version of this guideline (before the publication of that RFC and the registration of the media type) told to return `application/x.problem+json` in these cases (with the same contents). Servers for APIs defined before this change should pay attention to the `Accept` header sent by the client and set the `Content-Type` header of the problem response correspondingly. Clients of such APIs should accept both media types.

APIs may define custom problems types with extension properties, according to their specific needs.

The Open API schema definition can be found on github. You can reference it by using:

```
responses:
  503:
    description: Service Unavailable
    schema:
      $ref: 'https://zalando.github.io/problem/schema.yaml#/Problem'
```

Must: Do not expose Stack Traces

Stack traces contain implementation details that are not part of an API, and on which clients should never rely. Moreover, stack traces can leak sensitive information that partners and third parties are not allowed to receive and may disclose insights about vulnerabilities to attackers.

Must: Use common field names

There are some data fields that come up again and again in API data. We describe four here:

- `id` : the identity of the object. If used, IDs must opaque strings and not numbers. IDs are unique within some documented context, are stable and don't change for a given object once assigned, and are never recycled cross entities.
- `created` : when the object was created. If used this must be a date-time construct.
- `modified` : when the object was updated. If used this must be a date-time construct.
- `type` : the kind of thing this object is. If used this should be a string. Types allow runtime information on the entity provided that otherwise requires examining the Open API file.

These properties are not always strictly neccessary, but making them idiomatic allows API client developers to build up a common understanding of Zalando's resources. There is very little utility for API consumers in having different names or value types for these fields across APIs.

Common Headers

This section describes a handful of headers, which we found raised the most questions in our daily usage, or which are useful in particular circumstances but not widely known.

Must: Use Content Headers Correctly

Content or entity headers are headers with a `Content-` prefix. They describe the content of the body of the message and they can be used in both, HTTP requests and responses. Commonly used content headers include but are not limited to:

- `Content-Disposition` can indicate that the representation is supposed to be saved as a file, and the proposed file name.
- `Content-Encoding` indicates compression or encryption algorithms applied to the content.
- `Content-Length` indicates the length of the content (in bytes).
- `Content-Language` indicates that the body is meant for people literate in some human language(s).
- `Content-Location` indicates where the body can be found otherwise (see below for more details).
- `Content-Range` is used in responses to range requests to indicate which part of the requested resource representation is delivered with the body.
- `Content-Type` indicates the media type of the body content.

Must: Use Content-Location Correctly

This header is used in the response of either a successful read (GET, HEAD) or successful write operation (PUT, POST or PATCH).

In the case of the GET requests it points to a location where an alternate representation of the entity in the response body can be found. In this case one has to set the Content-Type header as well. For example:

```
GET /products/123/images HTTP/1.1

HTTP/1.1 200 OK
Content-Type: image/png
Content-Location: /products/123/images?format=raw
```

In the case of mutating HTTP methods, the Content-Location header can be used when there is a response body, and then it indicates that the included response body can be found at the location indicated in the header.

If the header value is the same as the location of the created resource (as indicated by the Location header after POST) or the modified resource (as indicated by the request URI after PUT / PATCH), then the returned body is indeed the current representation of the entity making a subsequent GET operation from the client side not necessary.

If your API returns the new representation after a PUT, PATCH, or POST you should include the Content-Location header to make it explicit, that the returned resource is an up-to-date version.

More details in rfc7231

Could: Use the Prefer header to indicate processing preferences

The `Prefer` header defined in RFC7240 allows clients to request processing behaviors from servers. RFC7240 pre-defines a number of preferences and is extensible, to allow others to be defined. Support for the Prefer header is entirely optional and at the discretion of API designers, but as an existing Internet Standard, is recommended over defining proprietary "X-" headers for processing directives.

The `Prefer` header can defined like this in an API definition:

```
Prefer:
  name: Prefer
  description: |
    The RFC7240 Prefer header indicates that particular server
    behaviors are preferred by the client but are not required
    for successful completion of the request.

    # (indicate the preferences supported by the API)

  in: header
  type: string
  required: false
```

Supporting APIs may return the `Preference-Applied` header also defined in RFC7240 to indicate whether the preference was applied.

Proprietary Headers

This section shares definitions of proprietary headers that should be named consistently because they address overarching service-related concerns. Whether services support these concerns or not is optional; therefore, the OpenAPI API specification is the right place to make this explicitly visible. Use the parameter definitions of the resource HTTP methods.

Header field name	Type	Description	Header field value example
X-Flow-ID	String	The flow id of the request, which is written into the logs and passed to called services. Helpful for operational troubleshooting and log analysis.	GKY7oDhpSiKY_gAAAABZ_A
X-UID	String	Generic user id of OpenId account that owns the passed (OAuth2) access token. E.g. additionally provided by OpenIG proxy after access token validation -- may save additional token validation round trips.	w435-dker-jdh357
X-Tenant-ID	String	The tenant id for future platform multitenancy support. *Should not be used unless new platform multitenancy is truly supported. But should be used by New Platform Prototyping services.* Must be validated for external retailer, supplier, etc. tenant users via OAuth2; details in clarification. Currently only used by New Platform Prototyping services.	9f8b3ca3-4be5-436c-a847-9cd55460c495
X-Sales-Channel	String	Sales channels are owned by retailers and represent a specific consumer segment being addressed with a specific product assortment that is offered via CFA retailer catalogs to consumers (see platform glossary [internal link])	101
X-Frontend-Type	String	Consumer facing applications (CFAs) provide business experience to their customers via different frontend application types, for instance, mobile app or browser. Info should be passed-through as generic aspect -- there are diverse concerns, e.g. pushing mobiles with specific coupons, that make use of it. Current range is mobile-app, browser, facebook-app, chat-app	mobile-app
X-Device-Type	String	There are also use cases for steering customer experience (incl. features and content) depending on device type. Via this header info should be passed-through as generic aspect. Current range is smartphone, tablet, desktop, other	tablet
X-Device-OS	String	On top of device type above, we even want to differ between device platform, e.g. smartphone Android vs. iOS. Via this header info should be passed-through as generic aspect. Current range is iOS, Android, Windows, Linux, MacOS	Android
X-App-Domain	Integer	The app domain (i.e. shop channel context) of the request. Note, app-domain is a legacy concept that will be replaced in new platform by combinations of main CFA concerns like retailer, sales channel, country	16

Remember that HTTP header field names are not case-sensitive.

Deprecation

Sometimes it is necessary to phase out an API endpoint (or version). I.e. this may be necessary if a field is no longer supported in the result or a whole business functionality behind an endpoint has to be shut down. There are many other reasons as well.

Must: Obtain Approval of Clients

Before shutting down an API (or version of an API) the producer must make sure, that all clients have given their consent to shut down the endpoint. Producers should help consumers to migrate to a potential new endpoint (i.e. by providing a migration manual). After all clients are migrated, the producer may shut down the deprecated API.

Must: External Partners Must Agree on Deprecation Timespan

If the API is consumed by any external partner, the producer must define a reasonable timespan that the API will be maintained after the producer has announced deprecation. The external partner (client) must agree to this minimum after-deprecation-lifespan before he starts using the API.

Must: Reflect Deprecation in API Definition

API deprecation must be part of the OpenAPI definition. If a method on a path, a whole path or even a whole API endpoint (multiple paths) should be deprecated, the producers must set `deprecated=true` on each method / path element that will be deprecated (OpenAPI 2.0 only allows you to define deprecation on this level). If deprecation should happen on a more fine grained level (i.e. query parameter, payload etc.), the producer should set `deprecated=true` on the affected method / path element and add further explanation to the `description` section.

If `deprecated` is set to `true`, the producer must describe what clients should use instead and when the API will be shut down in the `description` section of the API definition.

Must: Monitor Usage of Deprecated APIs

Owners of APIs used in production must monitor usage of deprecated APIs until the API can be shut down in order to align deprecation and avoid uncontrolled breaking effects. See also the general rule on API usage monitoring

Should: Add a Warning Header to Responses

During deprecation phase, the producer should add a `Warning` header (see RFC 7234 - Warning header) field. When adding the `Warning` header, the `warn-code` must be `299` and the `warn-text` should be in form of *"The path/operation/parameter/... {name} is deprecated and will be removed by {date}. Please see {link} for details."* with a link to a documentation describing why the API is no longer supported in the current form and what clients should do about it. Adding the `Warning` header is not sufficient to gain client consent to shut down an API.

Should: Add Monitoring for Warning Header

Clients should monitor the `Warning` header in HTTP responses to see if an API will be deprecated in future.

Must: Not Start Using Deprecated APIs

Clients must not start using deprecated parts of an API.

API Operation

Must: Provide Online Access to OpenAPI Reference Definition

All service applications must support access to the OpenAPI Reference Definitions of their external APIs — it is optional for internal APIs — via the following two API endpoints:

- endpoint(s) for GET access on its OpenAPI definition(s), for instance `https://example.com/swagger.json` or `https://example.com/swagger.yaml`.
- "Twintip" discovery endpoint `https://example.com/.well-known/schema-discovery` that delivers the OpenAPI definition endpoint(s) above (see the link below for a description of its format).

Hint: Though discovery endpoints have to be supported, they should not be specified in the OpenAPI definition as they are generic and provide no API specific information.

We distinguish between internal and external APIs of an application which is owned by a specific team and often implemented via small set of services. An external API is used by clients outside the team - usually another application owned by a different team or even an external business partner user of our platform. An internal API is only used within the application and only by the owning team, for instance, for operational or implementation internal purposes.

Background: In our dynamic and complex service infrastructure, it is important to provide API client developers a central place with online access to the OpenAPI reference definitions of all running applications. Twintip is an API definition crawler of the Zalando platform infrastructure; it checks all running applications via the endpoint above and stores the discovered API definitions. Twintip itself provides a RESTful API as well as an API Viewer (Swagger-UI) for central access to all discovered API definitions.

Editorial: For the time being, this document is an appropriate place to mention this rule, even though it is not a RESTful API definition rule but related to service implementation obligations to support client developer API discovery.

Further reading:

- Library to make your Spring Boot service crawlable via Twintip

Should: Monitor API Usage

Owners of APIs used in production should monitor API service to get information about its using clients. This information, for instance, is useful to identify potential review partner for API changes.

Hint: A preferred way of client detection implementation is by logging of the client-id retrieved from the OAuth token.

Events

Zalando’s architecture centers around decoupled microservices and in that context we favour asynchronous event driven approaches. The Nakadi framework provides an event publish and subscribe system, abstracting exchanges through a RESTful API.

Nakadi is a key element for data integration in the architecture, and the standard system for inter-service event messaging. The guidelines in this section are for use with the Nakadi framework and focus on how to design and publish events intended to be shared for others to consume. Critically, once events pass service boundaries they are considered part of the service API and are subject to the API guidelines.

Must: Treat Events as part of the service interface

Events are part of a service’s interface to the outside world equivalent in standing to a service’s REST API. Services publishing data for integration must treat their events as a first class design concern, just as they would an API. For example this means approaching events with the "API first" principle in mind as described in the Introduction and making them available for review.

Must: Ensure that Events define useful business resources

Events are intended to be used by other services including business process/data analytics and monitoring. They should be based around the resources and business processes you have defined for your service domain and adhere to its natural lifecycle (see also "Should: Define useful resources" in the General Guidelines).

As there is a cost in creating an explosion of event types and topics, prefer to define event types that are abstract/generic enough to be valuable for multiple use cases, and avoid publishing event types without a clear need.

Must: Ensure that Event Types conform to Nakadi's API

Nakadi defines a structure called an *EventType*, which describes details for a particular kind of event. The EventType declares standard information, such as a name, an owning application (and by implication, an owning team), a well known event category (business process or data change), and a schema defining the event payload. It also allows the declaration of validation and enrichment strategies for events, along with supplemental information such as how events are partitioned in the stream.

An EventType is registered with Nakadi via its *Schema Registry API*. Once the EventType is created, individual events that conform to the type and its payload schema can be published, and consumers can access them as stream of Events. Nakadi's Open API definitions include the definitions for two main categories, business events (BusinessEvent), and data change events (DataChangeEvent), as well as a generic 'undefined' type.

The service specific data defined for an event is called the *payload*. Only this non-Nakadi defined part of the event is expected to be submitted with the EventType schema. When defining an EventType's payload schema as part of your API and for review purposes, it's ok to declare the payload as an object definition using Open API, but please note that Nakadi currently expects the EventType's schema to be submitted as JSON Schema and not as Open API JSON or YAML. Further details on how to register EventTypes are available in the Nakadi project's documentation.

Must: Events must not provide sensitive customer personal data.

+Similar to API permission scopes, there will be Event Type permissions passed via an OAuth token supported in near future by the Nakadi API. Hence, Nakadi will restrict event data access to clients with sufficient authorization. However, teams are asked to note the following:

- Sensitive data, such as (e-mail addresses, phone numbers, etc) are subject to strict access and data protection controls.

- Event type owners **must not** publish sensitive information unless it's mandatory or neccessary to do so. For example, events sometimes need to provide personal data, such as delivery addresses in shipment orders (as do other APIs), and this is fine.

Must: Use Business Events to signal steps and arrival points in business processes

Nakadi defines a specific event type for business processes, called BusinessEvent. When publishing events that represent steps in a business process, event types must be based on the BusinessEvent type.

All your events of a single business process will conform to the following rules:

- Business events must contain a specific identifier field (a business process id or "bp-id") similar to flow-id to allow for efficient aggregation of all events in a business process execution.
- Business events must contain a means to correctly order events in a business process execution. In distributed settings where monotically increasing values (such as a high precision timestamp that is assured to move forwards) cannot be obtained, Nakadi provides a `parent_eids` data structure that allows causal relationships to be declared between events.
- Business events should only contain information that is new to the business process execution at the specific step/arrival point.
- Each business process sequence should be started by a business event containing all relevant context information.
- Business events must be published reliably by the service.

At the moment we cannot state whether it's best practice to publish all the events for a business process using a single event type and represent the specific steps with a state field, or whether to use multiple event types to represent each step. For now we suggest assessing each option and sticking to one for a given business process.

Must: Use Data Change Events to signal mutations

Nakadi defines an event for signalling data changes, called a DataChangeEvent. When publishing events that represents created, updated, or deleted data, change event types must be based on the DataChangeEvent category.

- Change events must identify the changed entity to allow aggregation of all related events for the entity.
- Change events should contain a means of ordering events for a given entity (such as created or updated timestamps that are assured to move forwards with respect to the entity, or version identifiers provided by some databases). Note that basing events on data structures that can be converged upon (such as CRDTs or logical clocks) in a distributed setting are outside the scope of this guidance.
- Change events must be published reliably by the service.

Should: Use the hash partition strategy for Data Change Events

The `hash` partition strategy allows a producer to define which fields in an event are used as input to compute the partition the event should be added to.

The `hash` option is particulary useful for data changes as it allows all related events for an entity to be consistently assigned to a partition, providing an ordered stream of events for that entity as they arrive at Nakadi. This is because while each partition has a total ordering, ordering across partitions is not assured, thus it is possible for events sent across partitions to appear in a different order to consumers that the order they arrived at the server. Note that as of the time of writing, random is the default option in Nakadi and thus the `hash` option must be declared when creating the event type.

When using the `hash` strategy the partition key in almost all cases should represent the entity being changed and not a per event or change identifier such as the `eid` field or a timestamp. This ensures data changes arrive at the same partition for a given entity and can be consumed effectively by clients.

There may be exceptional cases where data change events could have their partition strategy set to be the producer defined or random options, but generally `hash` is the right option - that is while the guidelines here are a "should", they can be read as "must, unless you have a very good reason".

Should: Ensure that Data Change Events match API representations

A data change event's representation of an entity should correspond to the REST API representation.

There's value in having the fewest number of published structures for a service. Consumers of the service will be working with fewer representations, and the service owners will have less API surface to maintain. In particular, you should only publish events that are interesting in the domain and abstract away from implementation or local details - there's no need to reflect every change that happens within your system.

There are cases where it could make sense to define data change events that don't directly correspond to your API resource representations. Some examples are -

- Where the API resource representations are very different from the datastore representation, but the physical data are easier to reliably process for data integration.
- Publishing aggregated data. For example a data change to an individual entity might cause an event to be published that contains a coarser representation than that defined for an API
- Events that are the result of a computation, such as a matching algorithm, or the generation of enriched data, and which might not be stored as entity by the service.

Must: Indicate ownership of Event Types

Event definitions must have clear ownership - this can be indicated via the `owning_application` field of the EventType.

Typically there is one producer application, which owns the EventType and is responsible for its definition, akin to how RESTful API definitions are managed. However, the owner may also be a particular service from a set of multiple services that are producing the same kind of event. Please note indicating that a specific application is producing or consuming a specific event type is not yet defined explicitly, but a subject of Nakadi service discovery support functions.

Must: Define Event Payloads in accordance with the overall Guidelines

Events must be consistent with other API data and the API Guidelines in general.

Everything expressed in the Introduction to these Guidelines is applicable to event data interchange between services. This is because our events, just like our APIs, represent a commitment to express what our systems do and designing high-quality, useful events allows us to develop new and interesting products and services.

What distinguishes events from other kinds of data is the delivery style used, asynchronous publish-subscribe messaging. But there is no reason why they could not be made available using a REST API, for example via a search request or as a paginated feed, and it will be common to base events on the models created for the service's REST API.

The following existing guideline sections are applicable to events -

- General Guidelines
- Naming
- Data Formats
- Common Data Objects

- Hypermedia -

There are a couple of technical considerations to bear in mind when defining event schema -

Note that Nakadi currently requires Open API event definitions to be submitted in JSON Schema syntax, and does not yet support Open API YAML. It's ok to define your events for peer review in YAML to avoid maintaining duplicate representations. This is best understood as point in time guidance - as the project develops it may support consuming Open API YAML (or other) structures directly, and the guidance here will be updated.

Must: Maintain backwards compatibility for Events

Changes to events must be based around making additive and backward compatible changes. This follows the guideline, "Must: Don’t Break Backward Compatibility" from the Compatibility guidelines.

In the context of events, compatibility issues are complicated by the fact that producers and consumers of events are highly asynchronous and can’t use content-negotiation techniques that are available to REST style clients and servers. This places a higher bar on producers to maintain compatibility as they will not be in a position to serve versioned media types on demand.

For event schema, these are considered backward compatible changes, as seen by consumers -

- Adding new optional fields to JSON objects.
- Changing the order of fields (field order in objects is arbitrary).
- Changing the order of values with same type in an array.
- Removing optional fields.
- Removing an individual value from an enumeration.

These are considered backwards-incompatible changes, as seen by consumers -

- Removing required fields from JSON objects.
- Changing the default value of a field.
- Changing the type of a field, object, enum or array.
- Changing the order of values with different type in an array (also known as a tuple).
- Adding a new optional field to redefine the meaning of an existing field (also known as a co-occurrence constraint).
- Adding a value to an enumeration (note that `x-extensible-enum` is not available in JSON Schema).

Must: Use unique Event identifiers

The `eid` (event identifier) value of an event must be unique.

The `eid` property is part of the standard metadata for an event and gives the event an identifier. Producing clients must generate this value when sending an event and it must be guaranteed to be unique from the perspective of the owning application. In particular events within a given event type's stream must have unique identifiers. This allows consumers to process the `eid` to assert the event is unique and use it as an idempotency check.

Note that uniqueness checking of the `eid` is not enforced by Nakadi at the event type or global levels and it is the responsibility of the producer to ensure event identifiers do in fact distinctly identify events. A straightforward way to create a unique identifier for an event is to generate a UUID value.

Must: Follow conventions for Event Type names

Event types can follow these naming conventions (each convention has its own should, must or could conformance level) -

- Event type names must be url-safe. This is because the event type names are used by Nakadi as part of the URL for the event type and its stream.
- Event type names should be lowercase words and numbers, using hypens, underscores or periods as separators.

References

This section collects links to documents to which we refer, and base our guidelines on.

OpenAPI Specification

- OpenAPI Specification

Publications, specifications and standards

- RFC 3339: Date and Time on the Internet: Timestamps
- RFC 5988: Web Linking
- RFC 7159: The JavaScript Object Notation (JSON) Data Interchange Format
- RFC 7230: Hypertext Transfer Protocol (HTTP/1.1): Message Syntax and Routing
- RFC 7231: Hypertext Transfer Protocol (HTTP/1.1): Semantics and Content
- RFC 7807: Problem Details for HTTP APIs
- ISO 8601: Date and time format
- ISO 3166-1 alpha-2: Two letter country codes
- ISO 639-1: Two letter language codes
- ISO 4217: Currency codes
- BCP 47: Tags for Identifying Languages

Dissertations

- Roy Thomas Fielding - Architectural Styles and the Design of Network-Based Software Architectures. This is the text which defines what REST is.

Books

- REST in Practice: Hypermedia and Systems Architecture
- Build APIs You Won't Hate
- InfoQ eBook - Web APIs: From Start to Finish

Blogs

- Lessons-learned blog: Thoughts on RESTful API Design

Tooling

API First Integrations

The following frameworks were specifically designed to support the API First workflow with OpenAPI YAML files (sorted alphabetically):

- Connexion: OpenAPI First framework for Python on top of Flask
- Friboo: utility library to write microservices in Clojure with support for Swagger and OAuth
- Play Swagger: build RESTful Play services from OpenAPI specification
- Swagger Codegen: template-driven engine to generate client code in different languages by parsing Swagger Resource Declaration
- Swagger Codegen Tooling: plugin for Maven that generates pieces of code from OpenAPI specification
- Swagger Plugin for IntelliJ IDEA: plugin to help you easily edit Swagger specification files inside IntelliJ IDEA

The Swagger/OpenAPI homepage lists more Community-Driven Language Integrations, but most of them do not fit our API First approach.

Support Libraries

These utility libraries support you in implementing various parts of our RESTful API guidelines (sorted alphabetically):

- Problem: Java library that implements application/problem+json
- Problems for Spring Web MVC: library for handling Problems in Spring Web MVC
- Jackson Datatype Money: extension module to properly support datatypes of javax.money
- JSON fields: framework for limiting fields of JSON objects exposed by Rest APIs
- Tracer: call tracing and log correlation in distributed systems
- TWINTIP: API definition crawler for the STUPS ecosystem
- TWINTIP Spring Integration: API discovery endpoint for Spring Web MVC

Changelog

This change log only contains major changes made after October 2016.

Non-major changes are editorial-only changes or minor changes of existing guidelines, e.g. adding new error code. Major changes are changes that come with additional obligations, or even change an existing guideline obligation. The latter changes are additionally labelled with "Rule Change" here.

To see a list of all changes, please have a look at the commit list in Github.

Rule Changes

- `2016-10-10:` Introduced the changelog. From now on all rule changes on API guidelines will be recorded here.