Visualizing API Patterns

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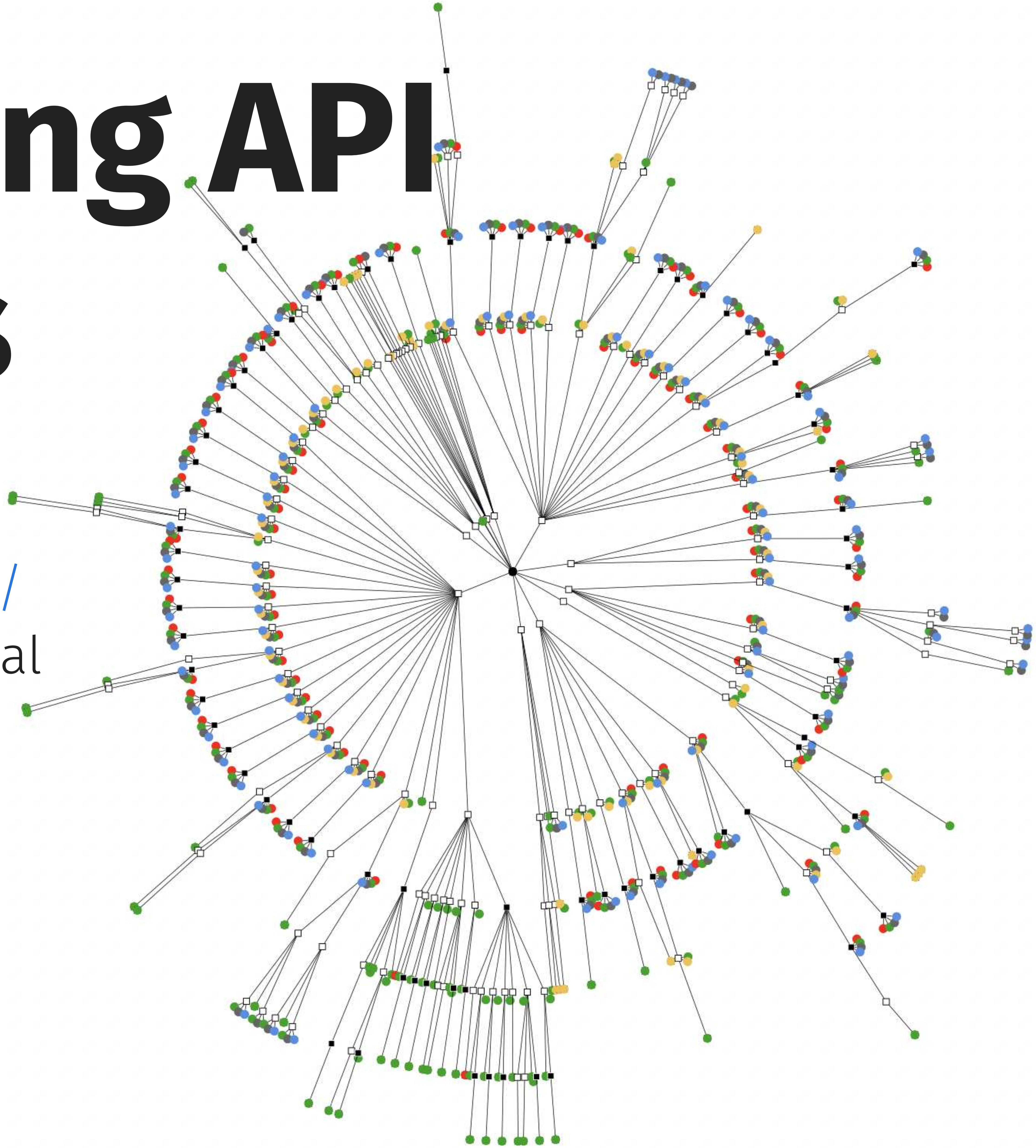
Hamburg, 12.5.23



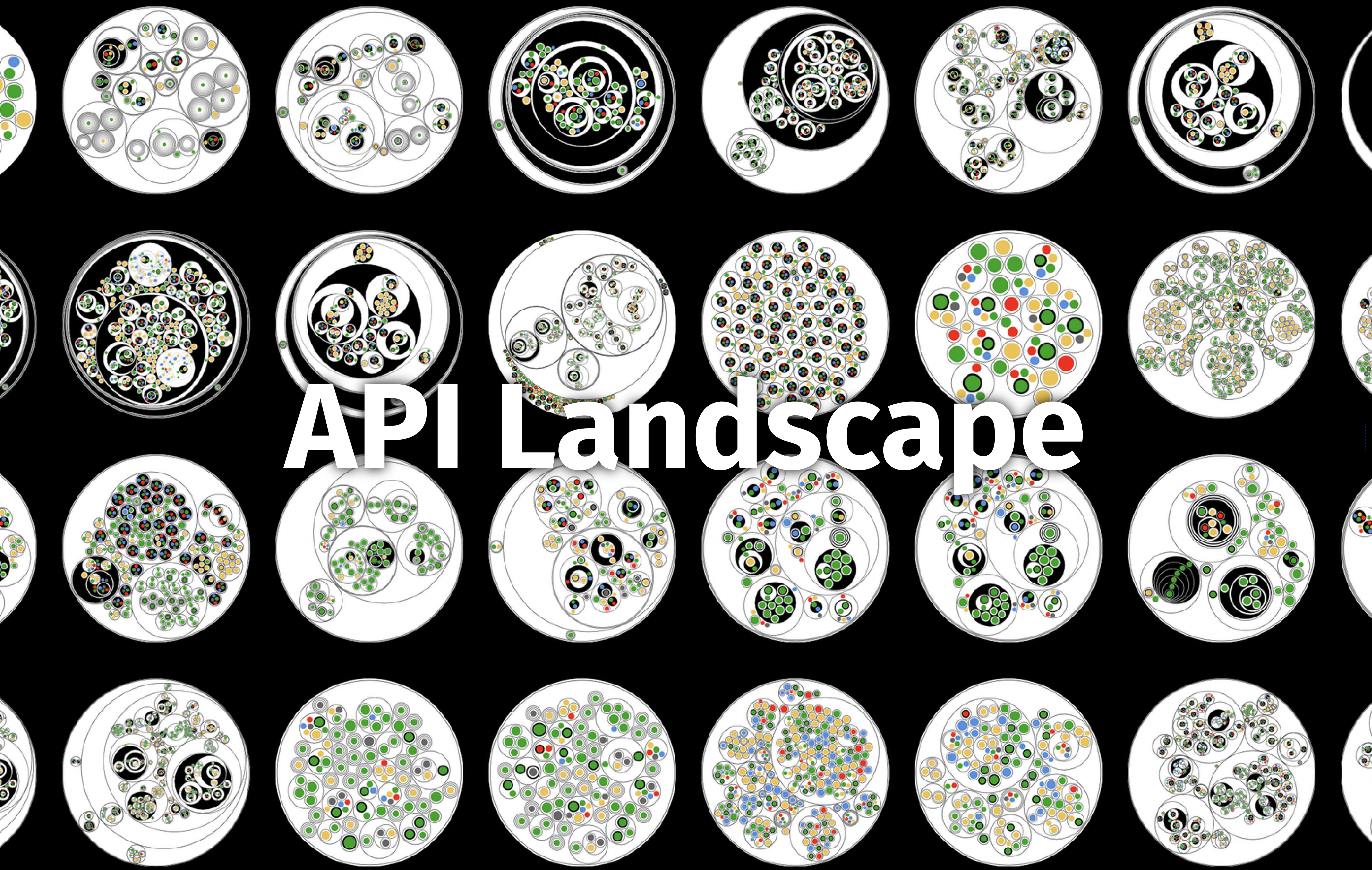
Contents

- API Landscape
- API Visualization
- API Design Patterns
  - Information Holders
  - Processing Resources
- API Evolution Patterns
  - Version Identifier
  - Two in Production

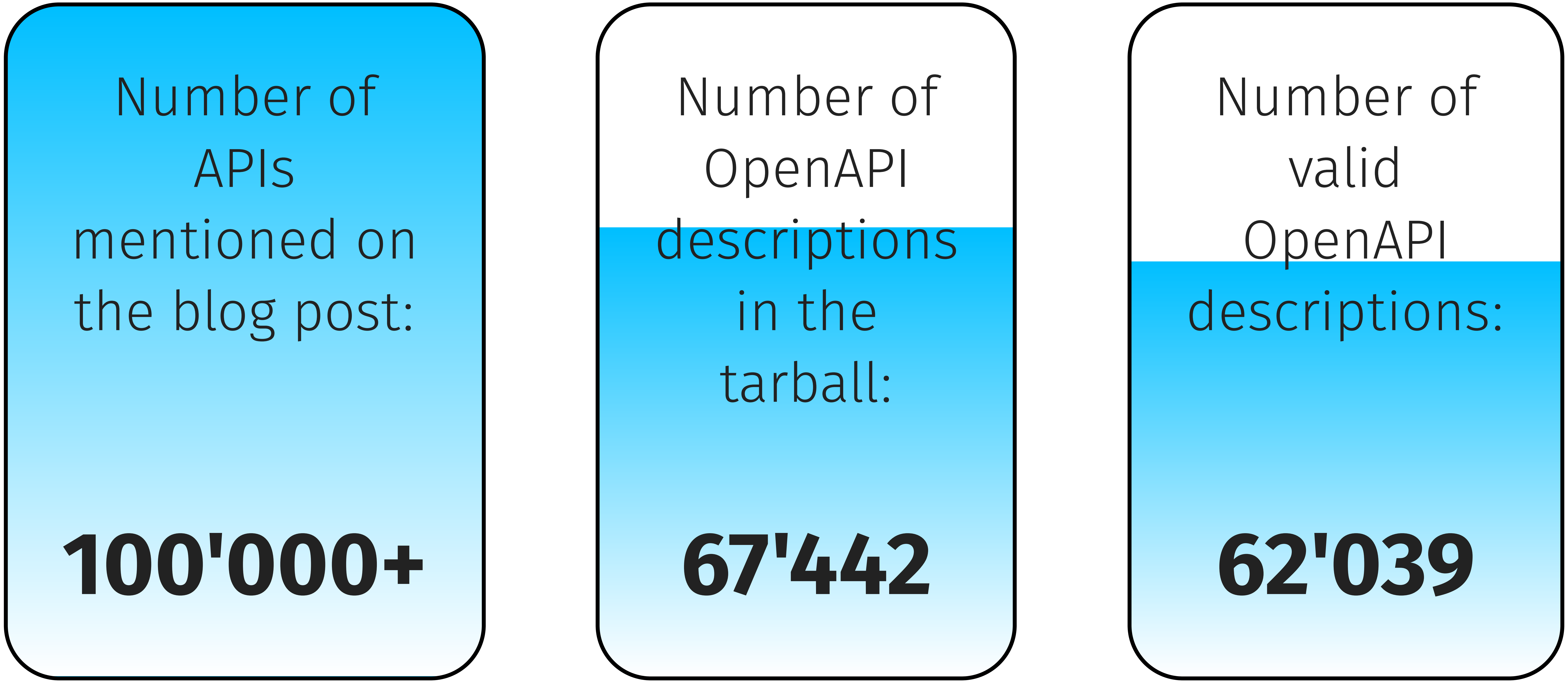
Abstract

In this talk we will visually explore a large collection of real-world Web APIs looking for usage examples of Patterns for API Design. We will reveal the diversity and variety of APIs while highlighting the fundamental nature of many API design patterns. Among others, we will present which are the most common HTTP endpoint structures for publishing Information Holders, how HTTP methods have been mapped to English verbs in Processing Resources, which are common Version Identifier formats, and how frequent are "Two-in-Production" API releases.

API Landscape



API Dataset



Number of APIs mentioned on the blog post:

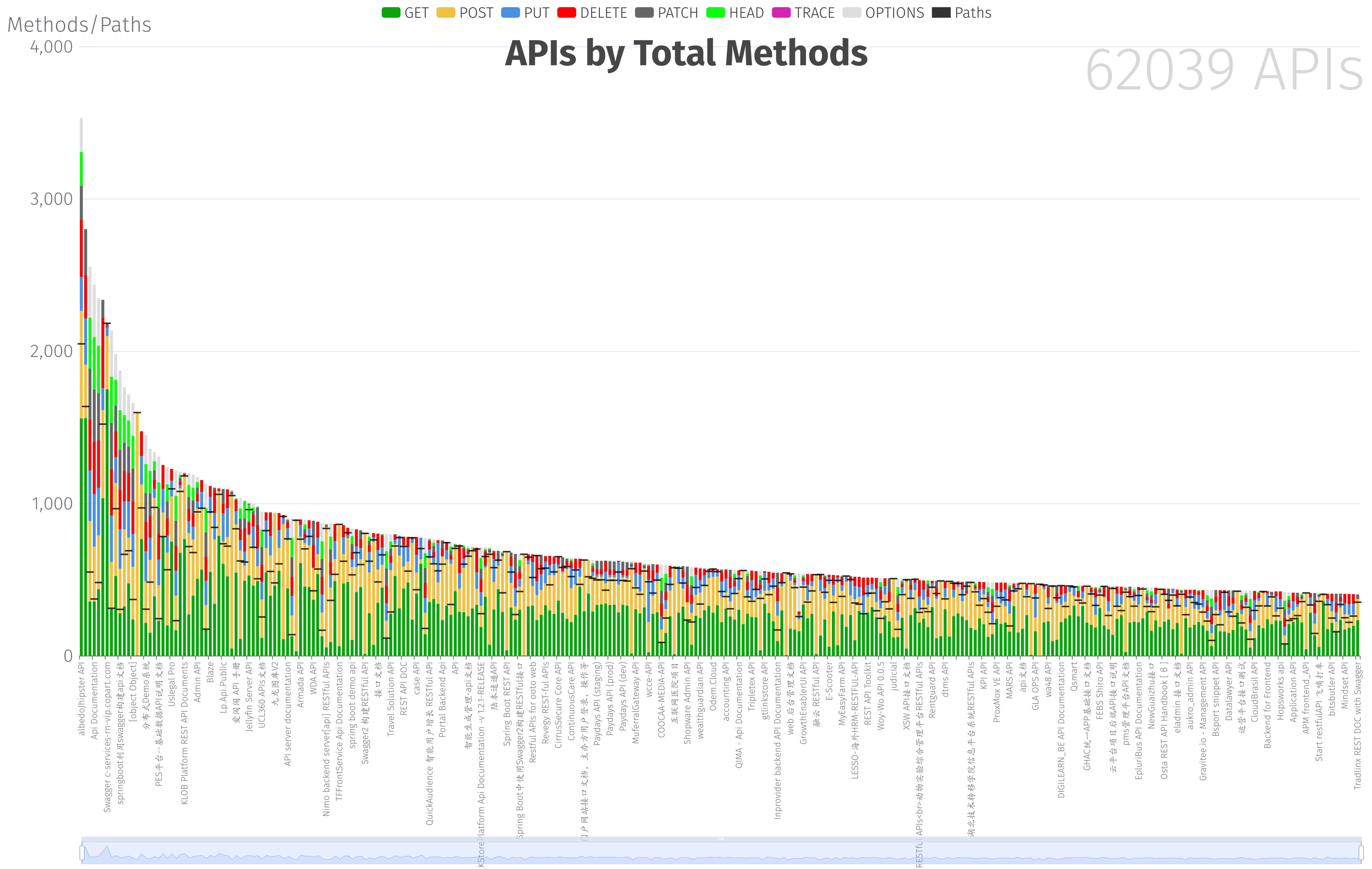
100'000+

Number of OpenAPI descriptions in the tarball:

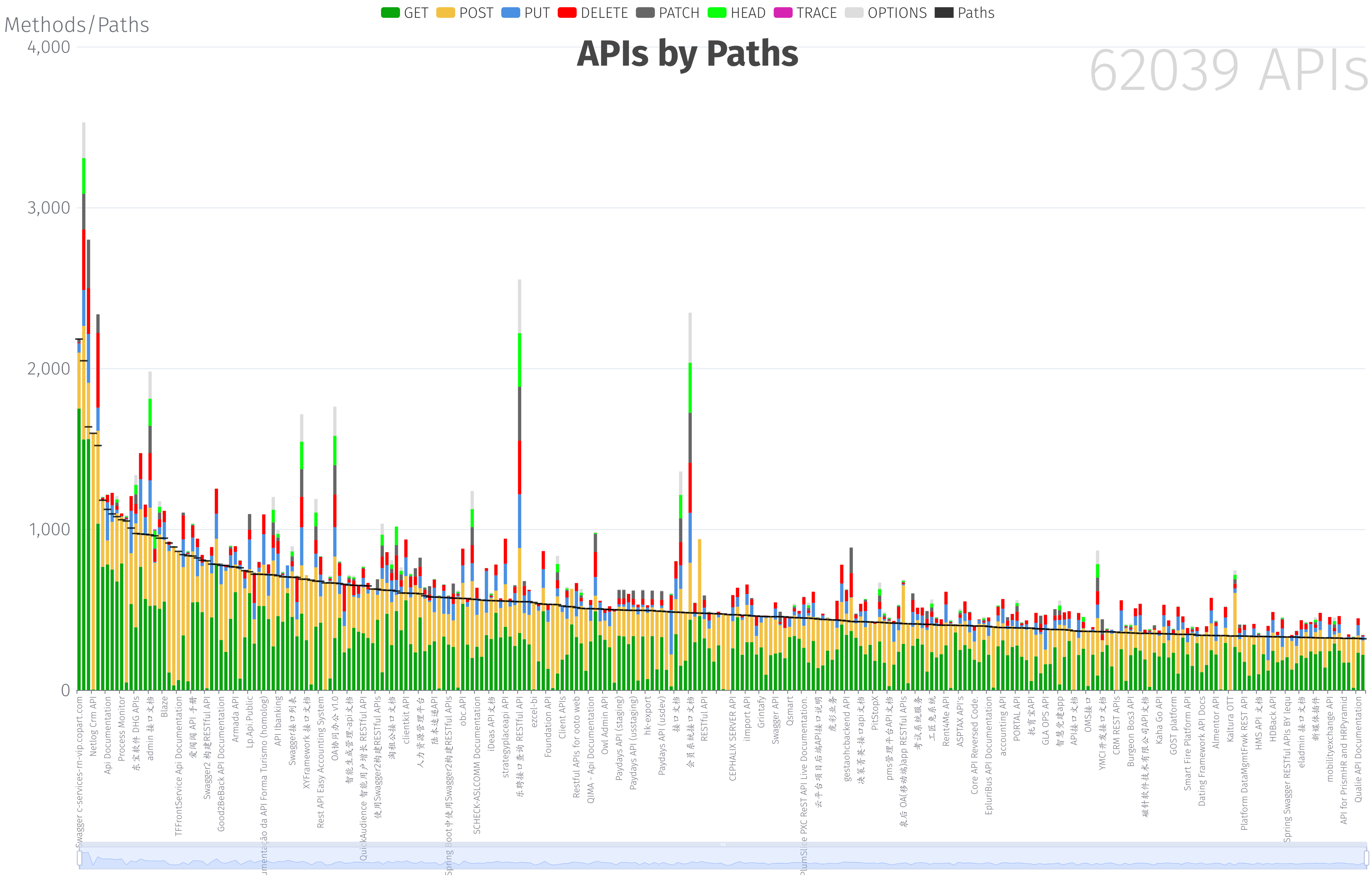
67'442

Number of valid OpenAPI descriptions:

62'039

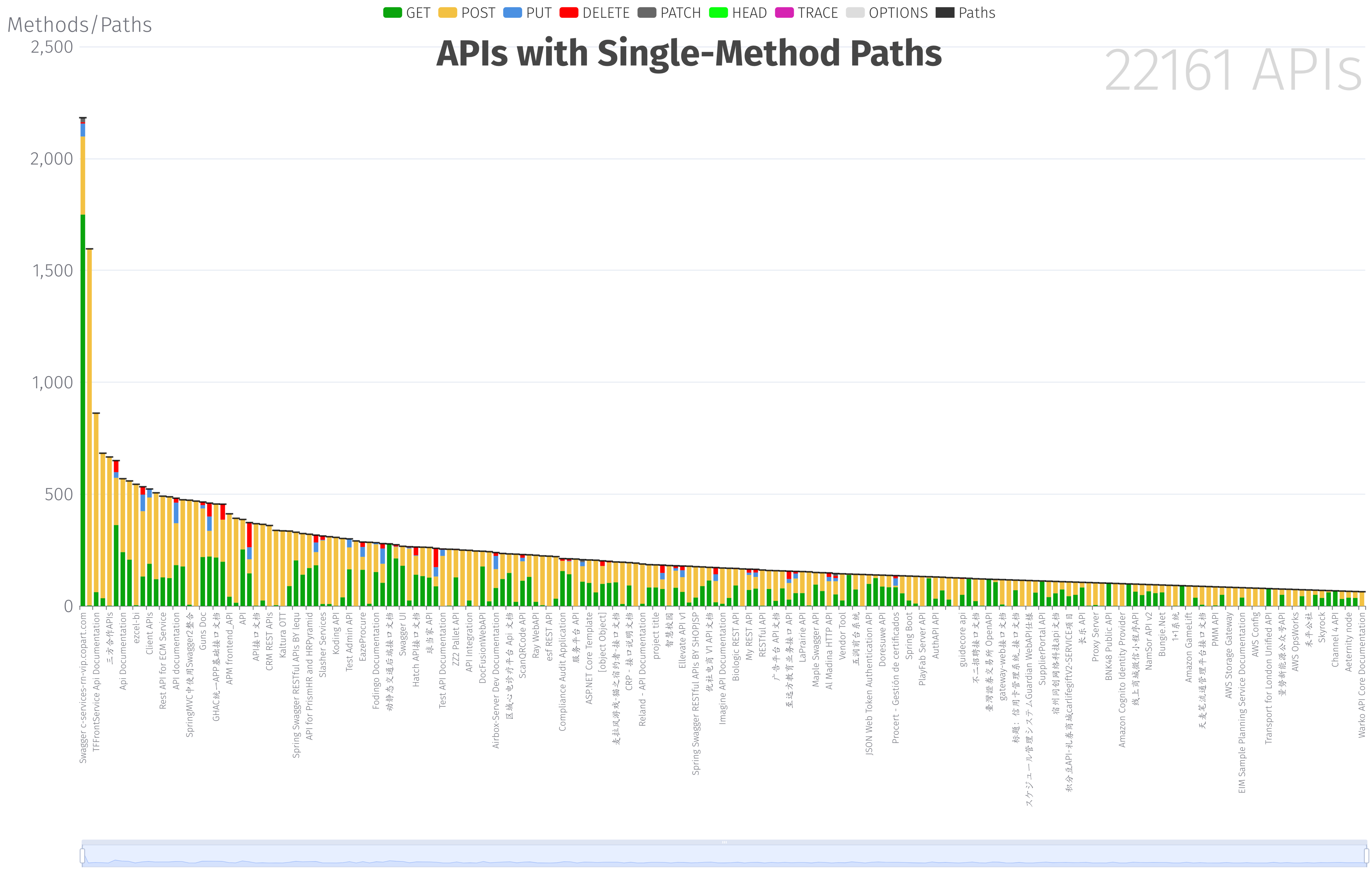


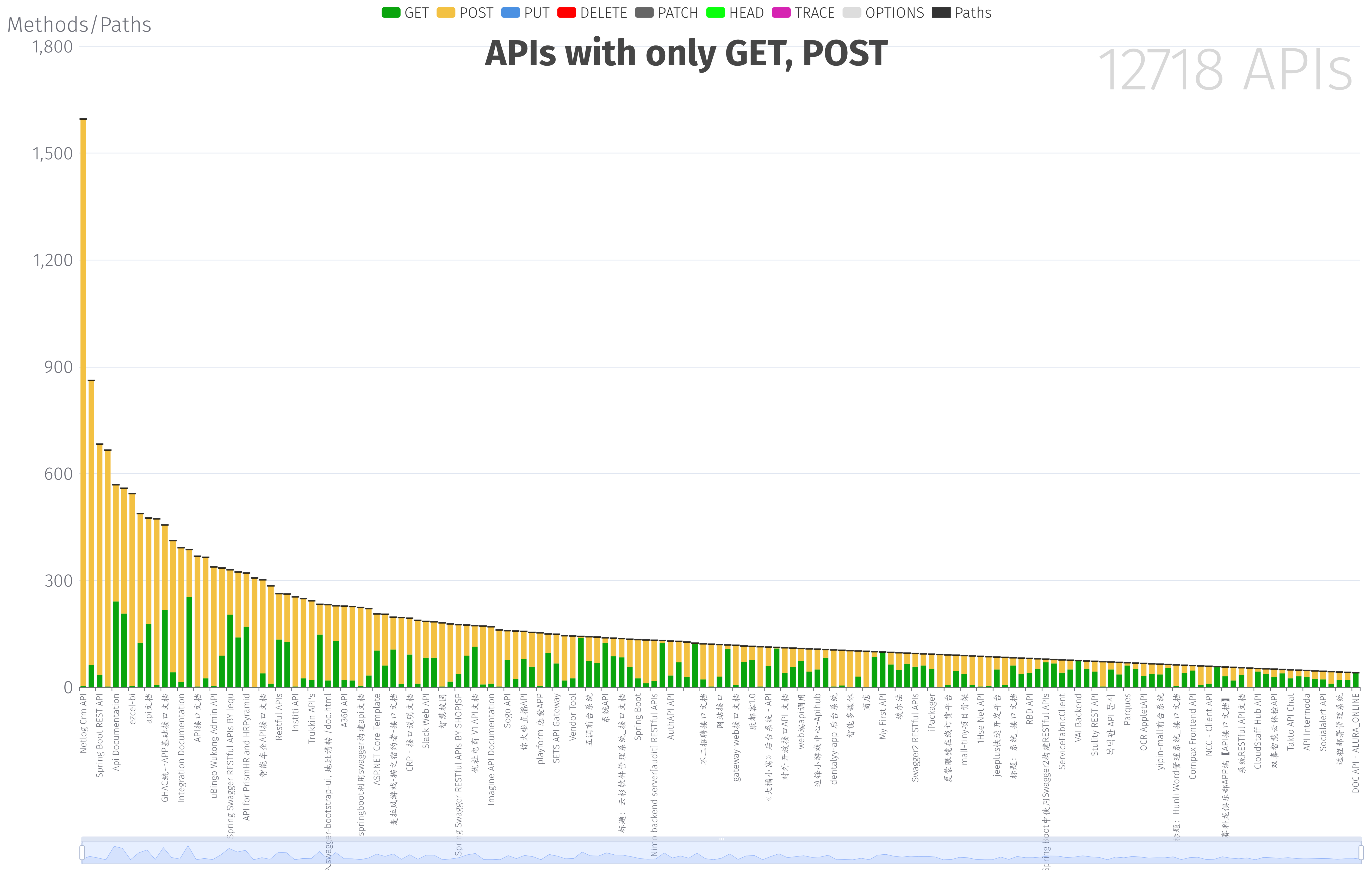
APIs by Total Methods



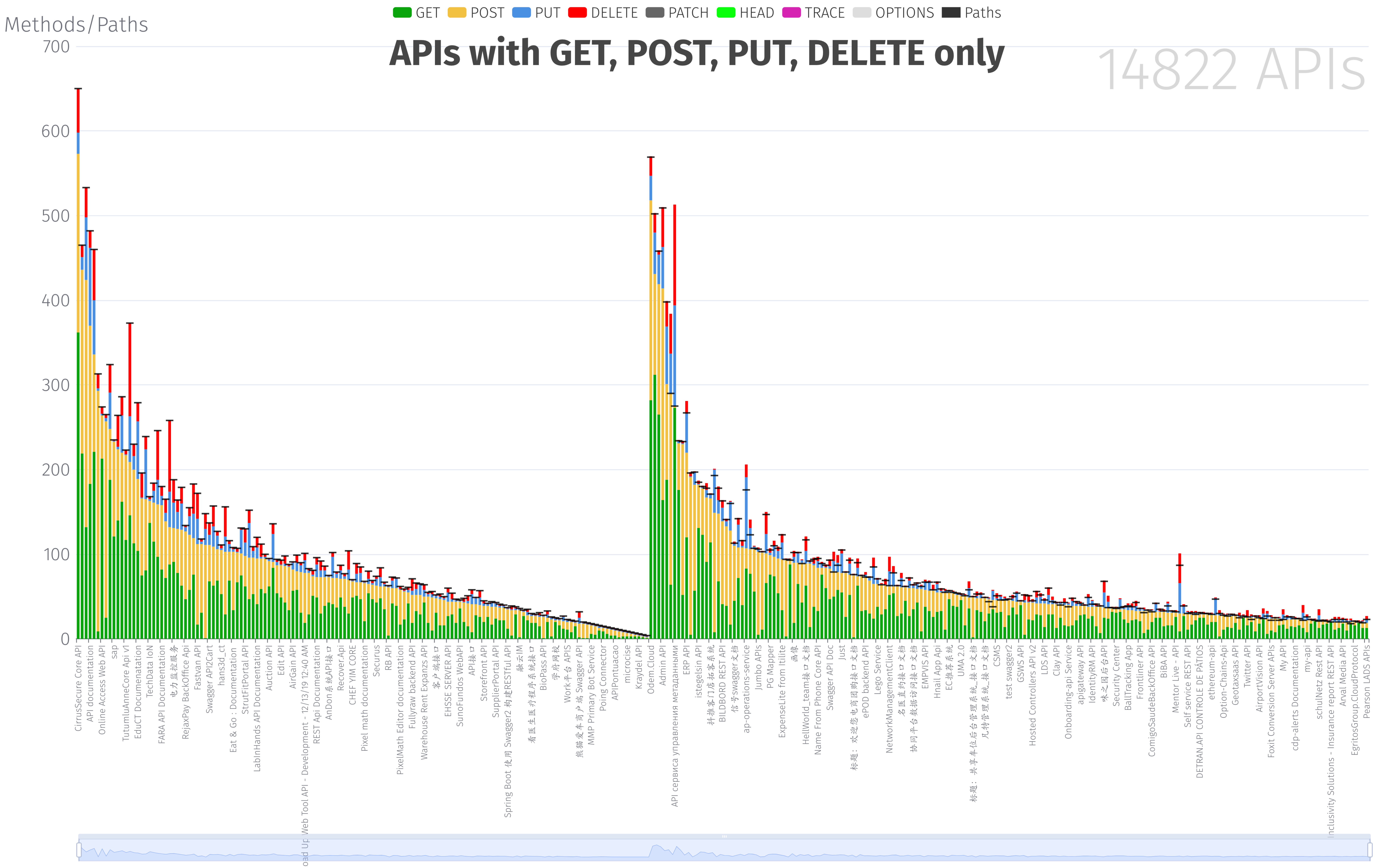
APIs by Paths

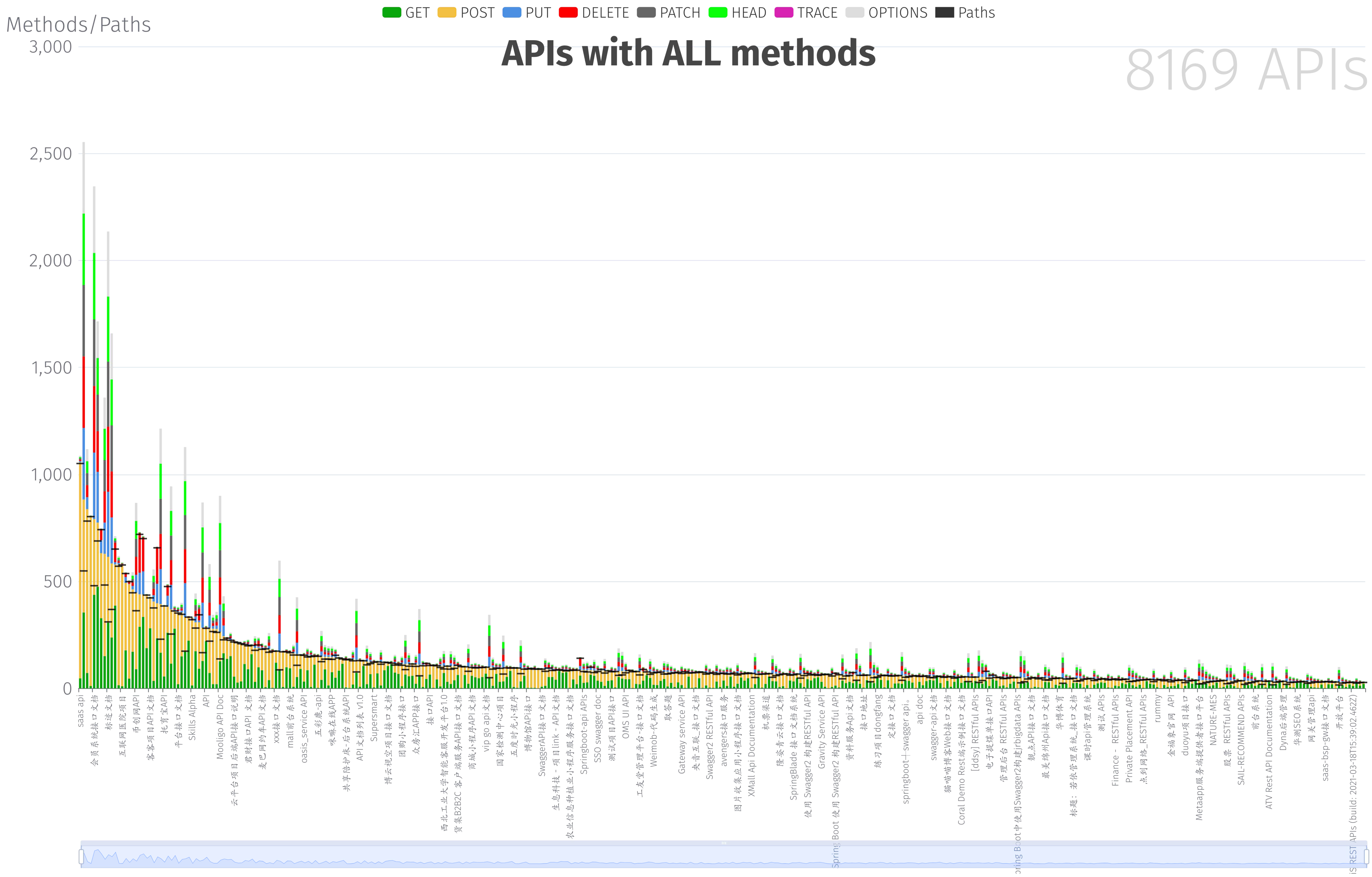
62039 APIs


GET
POST
PUT
DELETE
PATCH
HEAD
TRACE
OPTIONS
Paths
Methods / Paths
APIs with Single-Method Paths
22161 APIs
2,500
2,000
1,500
1,000
500
0
Swagger c-services-rn-vip.copart.com
TFFrontService Api Documentation
三方合作APIs
Api Documentation
ezcel-bi
Client APIs
Rest API for ECM Service
API documentation
SpringMVC中使用Swagger2整合
Guns Doc
GHAC统一APP基础接口文档
APM frontend_API
API
API接口文档
CRM REST APIs
Kaltura OTT
Spring Swagger RESTful APIs BY lequ
API for PrismHR and HRPyramid
Slasher Services
Koding API
Test Admin API
EazeProcure
Fodingo Documentation
动静态交通后端接口文档
Swagger UI
Hatch API接口文档
球当家 API
Test API Documentation
ZZ2 Pallet API
API Integration
DocFusionWebAPI
Airbox-Server Dev Documentation
区域心电诊疗平台 Api 文档
ScanQRCode API
Ray WebAPI
esf REST API
Compliance Audit Application
服务平台 API
ASP.NET Core Template
[object Object]
麦拉风游戏-猫之宿约者-接口文档
CRP - 接口说明文档
Reland - API Documentation
project title
智慧校园
Ellevate API v1
Spring Swagger RESTful APIs BY SHOPJSP
优社电商 V1 API 文档
Imagine API Documentation
Biologic REST API
My REST API
RESTful API
广告平台 API文档
至远方教育业务接口 API
LaPrairie API
Maple Swagger API
Al Madina HTTP API
Vendor Tool
五润前台系统
JSON Web Token Authentication API
Doresuwe API
Procert - Gestión de certificados
Spring Boot
PlayFab Server API
AuthAPI API
guidecore api
不二招聘接口文档
臺灣證券交易所 OpenAPI
gateway-web接口文档
标题：信用卡管理系统_接口文档
スケジュール管理システムGuardian WebAPI仕様
SupplierPortal API
宿州同创网络科技api文档
积分豆API-礼券商城carlifegiftV2-SERVICE项目
长乐 API
Proxy Server
BNK48 Public API
Amazon Cognito Identity Provider
线上商城微信小程序API
NamSor API v2
Bungie.Net
1+1系统
Amazon GameLift
天麦笔流通管理平台接口文档
PMM API
AWS Storage Gateway
EIM Sample Planning Service Documentation
AWS Config
Transport for London Unified API
量势新能源公众号API
AWS OpsWorks
禾平公社
Skyrock
Channel 4 API
Aeternity node
Warko API Core Documentation

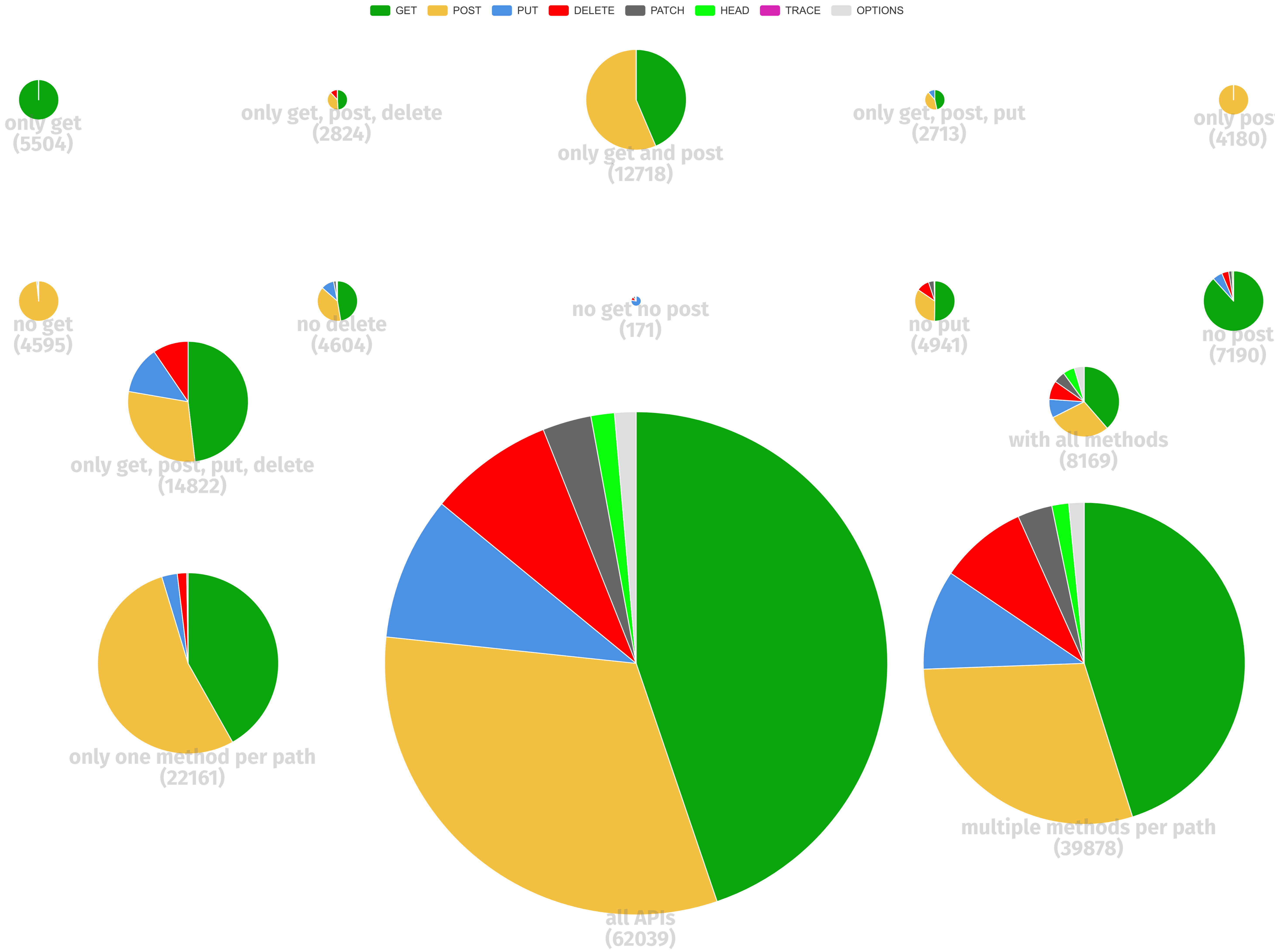


APIs with only GET, POST

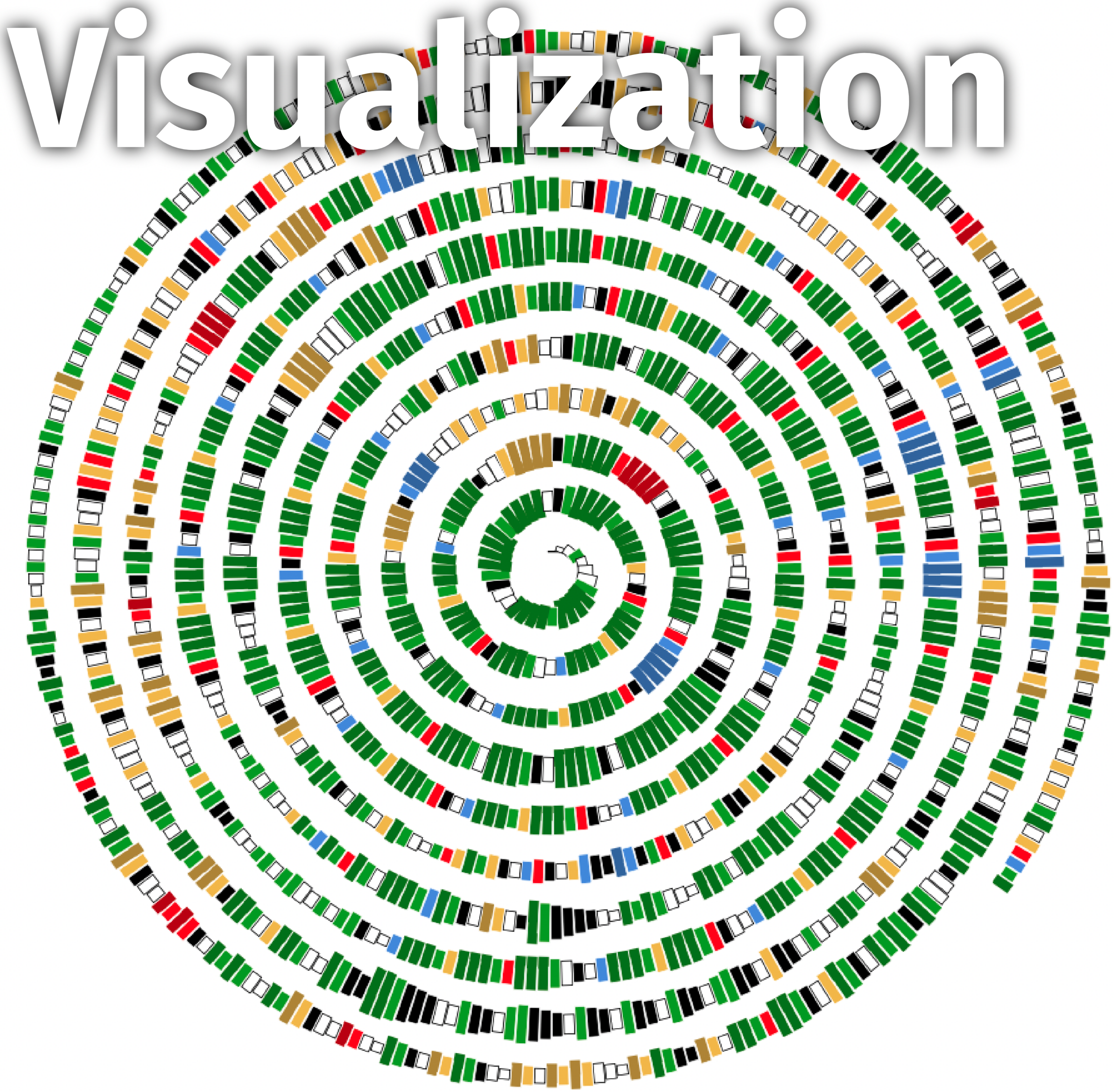

GET
POST
PUT
DELETE
PATCH
HEAD
TRACE
OPTIONS
Paths
Methods/Paths
APIs with GET, POST, PUT, DELETE only
14822 APIs
700
600
500
400
300
200
100
0
CirrusSecure Core API
API documentation
Online Access Web API
sap
TutumluAnneCore Api v1
EduCT Documenatation
TechData IoN
FARA API Documentation
电力监控服务
RejaxPay BackOffice Api
Fastvan API
Swagger API2Cart
hans3d_ct
Eat & Go : Documentation
StrutFitPortal API
LabInHands API Documentation
Auction API
Edit API
AirGain API
oad Up Web Tool API - Development - 12/13/19 12:40 AM
REST Api Documentation
AnDon系统API接口
Recover.Api
CHEF YIM CORE
Pixel math documentation
Securus
RB API
PixelMath Editor documentation
Fullyraw backend API
Warehouse Rent Expanzs API
客户端接口
EHSSE SERVER API
SunoFundos WebAPI
API接口
Storefront API
SupplierPortal API
Spring Boot 使用 Swagger2 构建RESTful API
融云IM
看医生医疗程序系统接口
BioPass API
学府网校
Work平台 APIS
熊猫爱车商户端 Swagger API
MMP Primary Bot Service
Poing Connector
APIPontuacao
microcise
Kraydel API
Odem.Cloud
Admin API
API сервиса управления метаданными
ERP API
istegelsin API
抖推客门店拓客系统
BILDBORD REST API
信号swagger文档
ap-operations-service
Jumbo APIs
PG Mapper
ExpenseLite from Itilite
画像
HellWorld_team接口文档
Name From Phone Core API
Swagger API Doc
Just
标题：欢迎您电商团购接口文档
ePOD backend API
Lego Service
NetworkManagementClient
名医直约接口文档
协同平台数据访问接口文档
EMPVIS API
Hnail App Api
EC推荐系统
UMA 2.0
标题：共享车位后台管理系统_接口文档
儿特管理系统_接口文档
CSMS
test swagger2
GSWS API
Hosted Controllers API v2
LDS API
Clay API
Onboarding-api Service
apigateway API
IdentityRM API
味之园后台API
Security Center
BallTracking App
Frontliner API
ComigoSaudeBackOffice API
BIBA API
Mentor Live - API
Self service REST API
DETRAN.API CONTROLE DE PÁTIOS
ethereum-api
Option-Chains-Api
Geotaxsaas API
Twitter API
AirportVision API
Foxit Conversion Server APIs
My API
cdp-alerts Documentation
my-api
schulNetz Rest API
Inclusivity Solutions - Insurance report REST API
Arval Media API
EgritosGroup.CloudProtocol
Pearson LADS APIs


🟩 GET
🟨 POST
🟦 PUT
🟥 DELETE
▨ PATCH
🟩 HEAD
🟪 TRACE
⬜ OPTIONS
⬛ Paths
Methods/Paths
APIs with ALL methods
8169 APIs
3,000
2,500
2,000
1,500
1,000
500
0
saas api
会员系统接口文档
标迹文档
互联网医院项目
币创网API
客客项目API文档
托育宝API
平台接口文档
Skills Alpha
API
Mooligo API Doc
云平台项目后端API接口说明
君财接口API 文档
麦巴网约车API文档
xxx接口文档
mall前台系统
oasis_service API
五彩鹿-api
咪嘛在线APP
共享陪护床-后台系统API
API文档列表 v1.0
Supersmart
博云视空项目接口文档
团购小程序接口
众房汇APP接口
接口API
西北工业大学智能客服开发平台1.0
货集B2B2C 客户端服务API接口文档
商城小程序API文档
vip go api文档
国家检测中心项目
五度时光小程序
博物馆API接口
SwaggerAPI接口文档
生息科技 - 项目link - API文档
农业信息种植业小程序服务接口文档
Springboot-api APIs
SSO swagger doc
测试项目API接口
OMS UI API
工友堂管理平台-接口文档
Weimob-代码生成
取答题
Gateway service API
央音互联_接口文档
Swagger2 RESTful API
avengers接口服务
图片收集应用小程序接口文档
XMall Api Documentation
机票渠道
隆姿青云接口文档
SpringBlade 接口文档系统
使用 Swagger2 构建RESTful API
Gravity Service API
Spring Boot 使用 Swagger2 构建RESTful API
资料服务Api文档
接口地址
练习项目dongfang
定接口文档
springboot+swagger api。
api doc
swagger-api文档
猫喵喵博客Web接口文档
Coral Demo Rest端示例接口文档
[ddsy] RESTful APIs
电子提煤单接口API
管理后台 RESTful APIs
Spring Boot中使用Swagger2构建jrbigdata APIs
靓点API接口文档
最美绵州Api接口文档
华博体育
标题： 若依管理系统_接口文档
课时api管理系统
测试 APIs
Finance - RESTful APIs
Private Placement API
点到网络_RESTful APIs
rummy
金福象官网 API
duoyu项目接口
Metaapp服务端提供者接口平台
NATURE-MES
股票 RESTful APIs
SAIL-RECOMMEND APIs
前台系统
ATV Rest API Documentation
Dyna后端管理
华测SEO系统
网关管理api
saas-bsp-gw接口文档
开放平台
iS REST APIs (build: 2021-03-18T15:39:02.462Z)

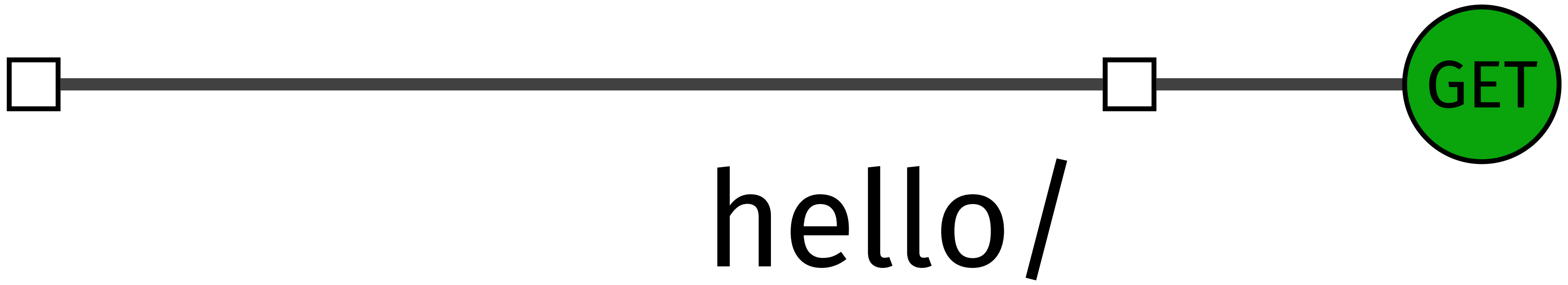
HTTP Method Combinations



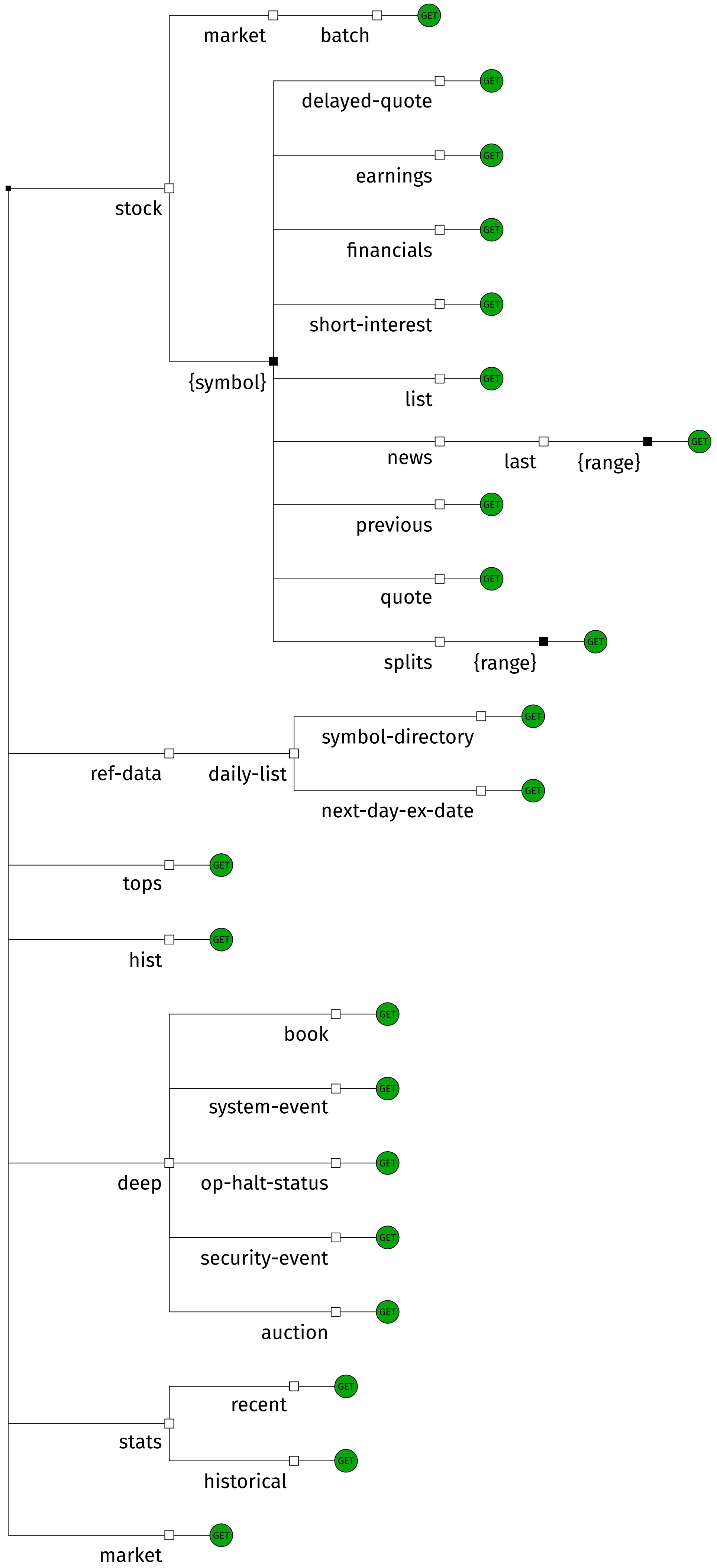
API Visualization



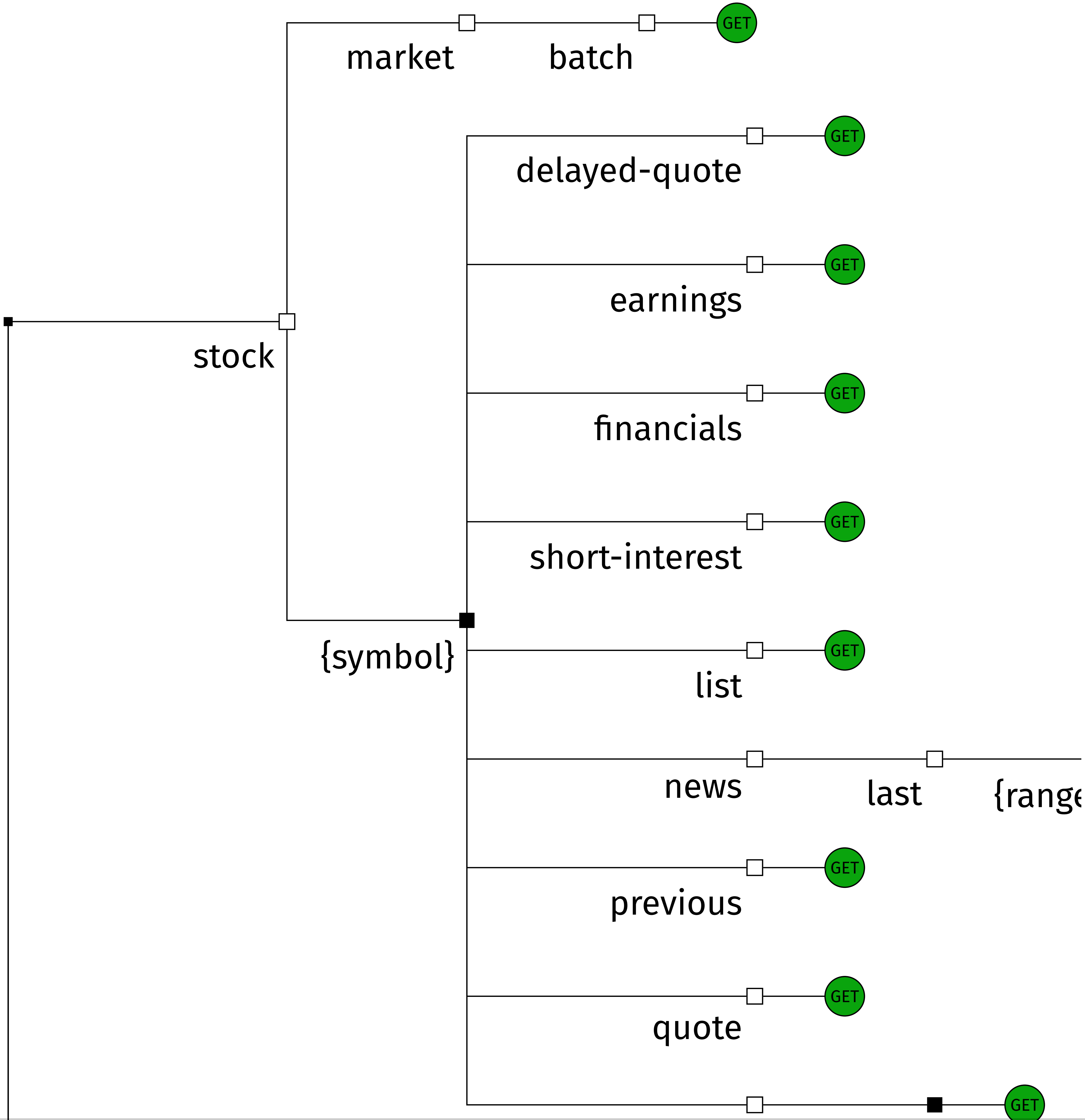
Operations = Resource Path + Method



Read-Only

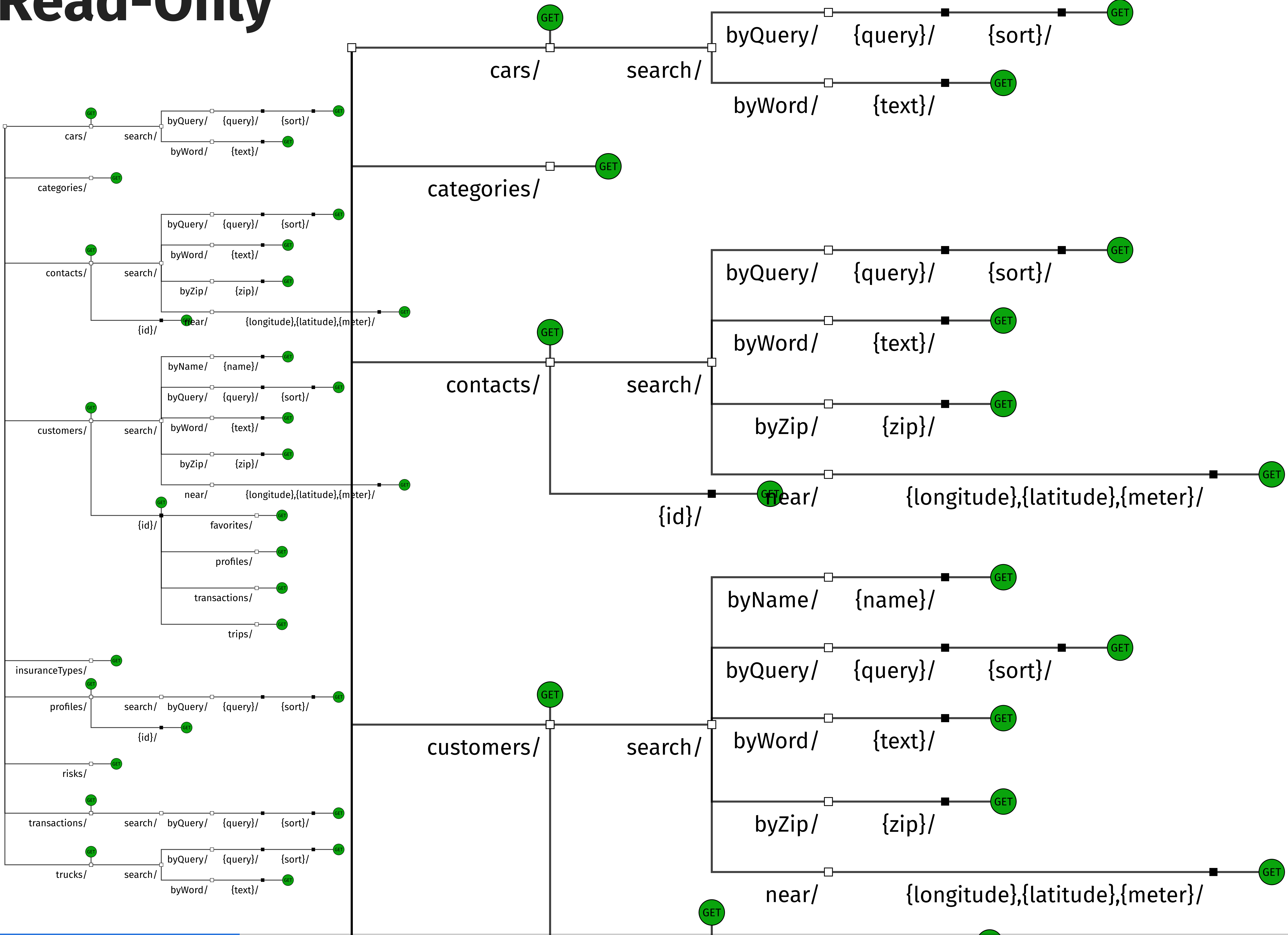


market
batch
GET
stock
delayed-quote
GET
earnings
GET
financials
GET
short-interest
GET
{symbol}
list
GET
news
last
{range}
GET
previous
GET
quote
GET
splits
{range}
GET
ref-data
daily-list
symbol-directory
GET
next-day-ex-date
GET
tops
GET
hist
GET
book
GET
system-event
GET
deep
op-halt-status
GET
security-event
GET
auction
GET
recent
GET
stats
historical
GET
market
GET



market
batch
GET
delayed-quote
GET
earnings
GET
stock
financials
GET
short-interest
GET
{symbol}
list
GET
news
last
{range
previous
GET
quote
GET
GET

Read-Only


cars/ GET search/ byQuery/ {query}/ {sort}/ GET

byWord/ {text}/ GET

categories/ GET

contacts/ GET search/ byQuery/ {query}/ {sort}/ GET

byWord/ {text}/ GET

byZip/ {zip}/ GET

near/ {longitude},{latitude},{meter}/ GET

{id}/ GET

customers/ GET search/ byName/ {name}/ GET

byQuery/ {query}/ {sort}/ GET

byWord/ {text}/ GET

byZip/ {zip}/ GET

near/ {longitude},{latitude},{meter}/ GET

{id}/ GET favorites/ GET

profiles/ GET

transactions/ GET

trips/ GET

insuranceTypes/ GET

profiles/ GET search/ byQuery/ {query}/ {sort}/ GET

{id}/ GET

risks/ GET

transactions/ GET search/ byQuery/ {query}/ {sort}/ GET

trucks/ GET search/ byQuery/ {query}/ {sort}/ GET

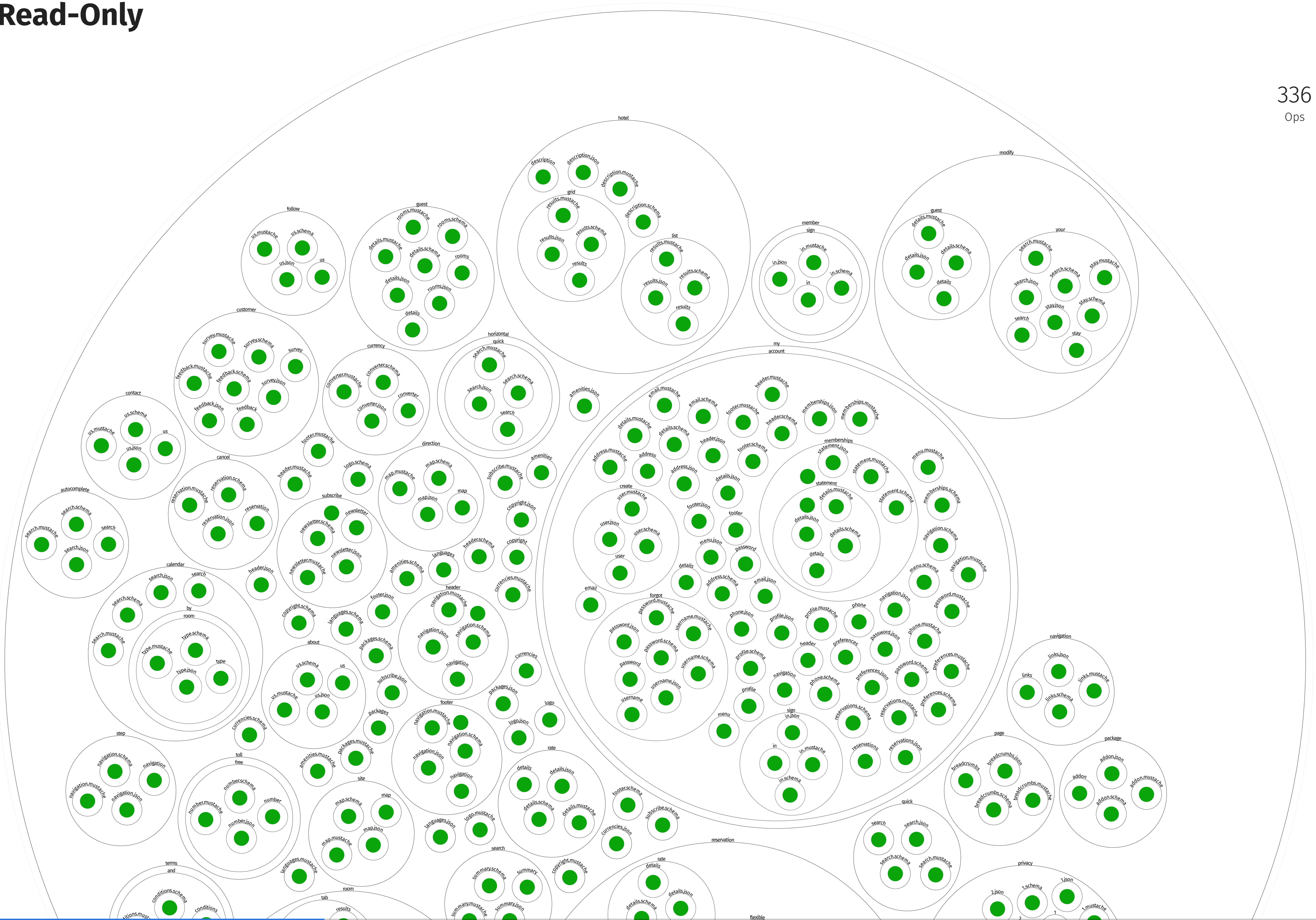
byWord/ {text}/ GET

Read-Only

1.0

336 Ops

336 Paths



GetPerVMTypeOneBootShutDownData

Read-Write

getAllVMTypesBootShutDownDataAvg GET

getAllVMTypesBootShutDownDataRegression GET

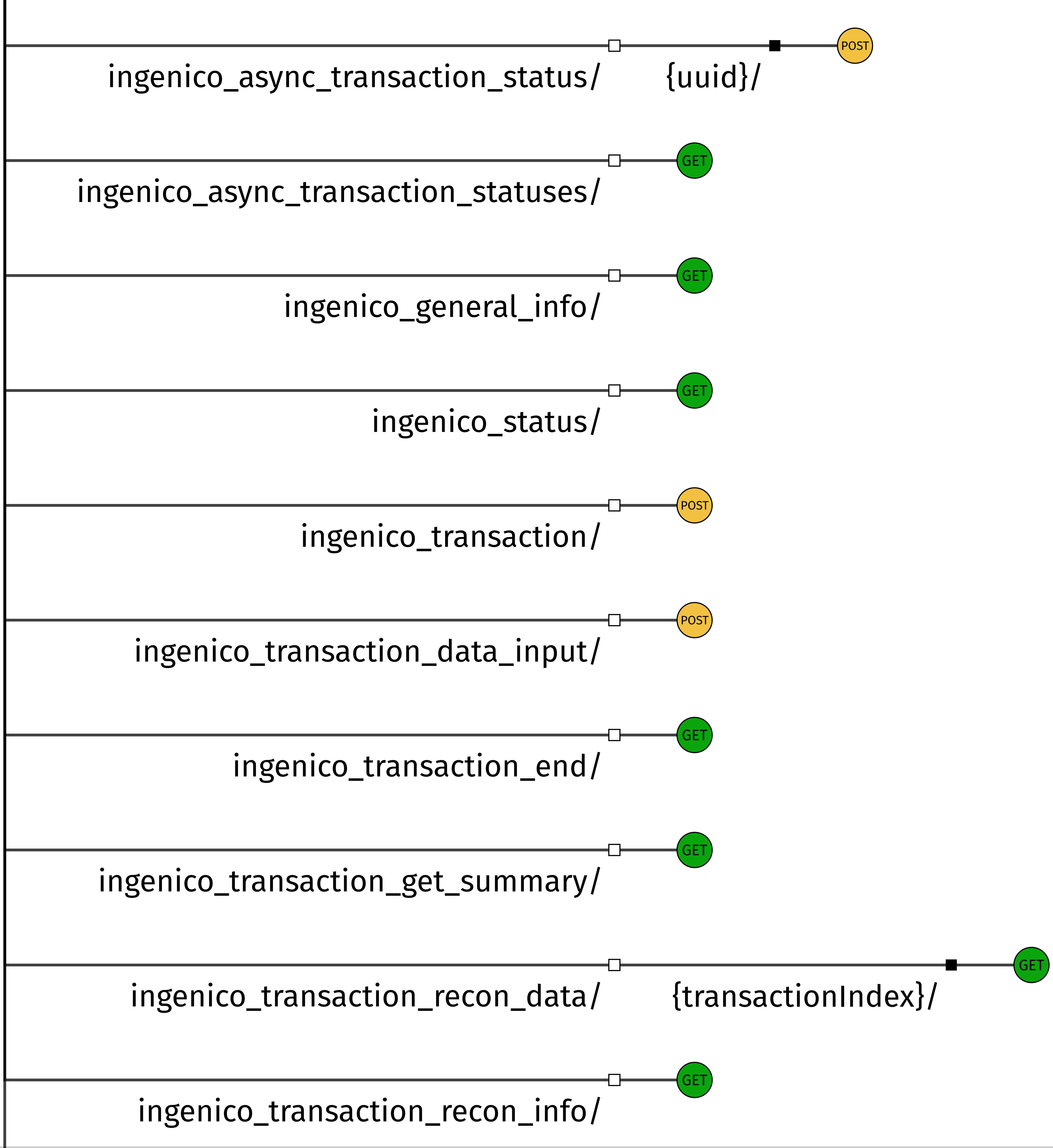
getPerVMTypeAllBootShutDownData GET

getandStoreRegressionValues GET

initUserConfig POST

listAllInstances GET

Read-Write



ingenico_async_transaction_status/ {uuid}/ POST

ingenico_async_transaction_statuses/ GET

ingenico_general_info/ GET

ingenico_status/ GET

ingenico_transaction/ POST

ingenico_transaction_data_input/ POST

ingenico_transaction_end/ GET

ingenico_transaction_get_summary/ GET

ingenico_transaction_recon_data/ {transactionIndex}/ GET

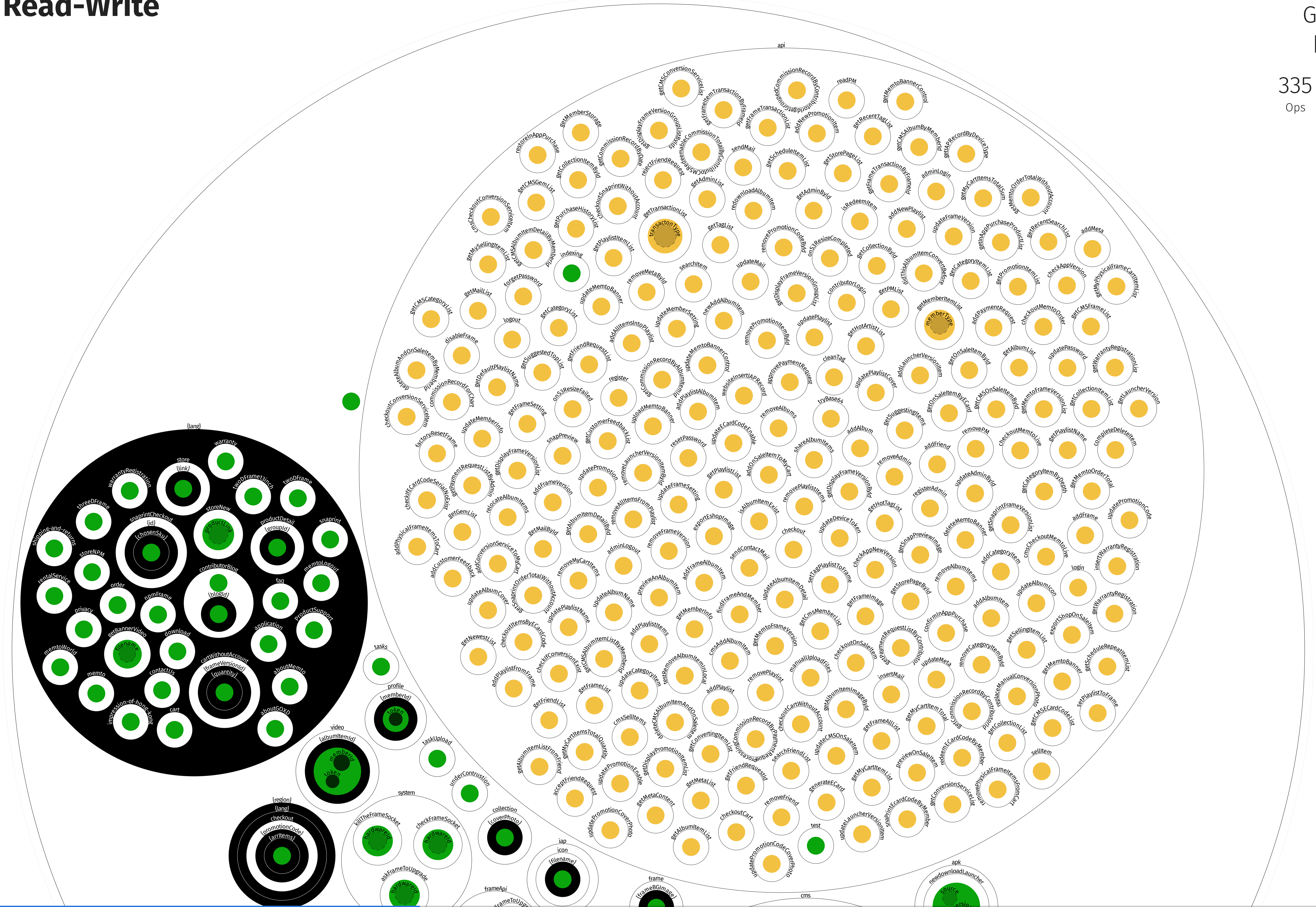
ingenico_transaction_recon_info/ GET

Read-Write

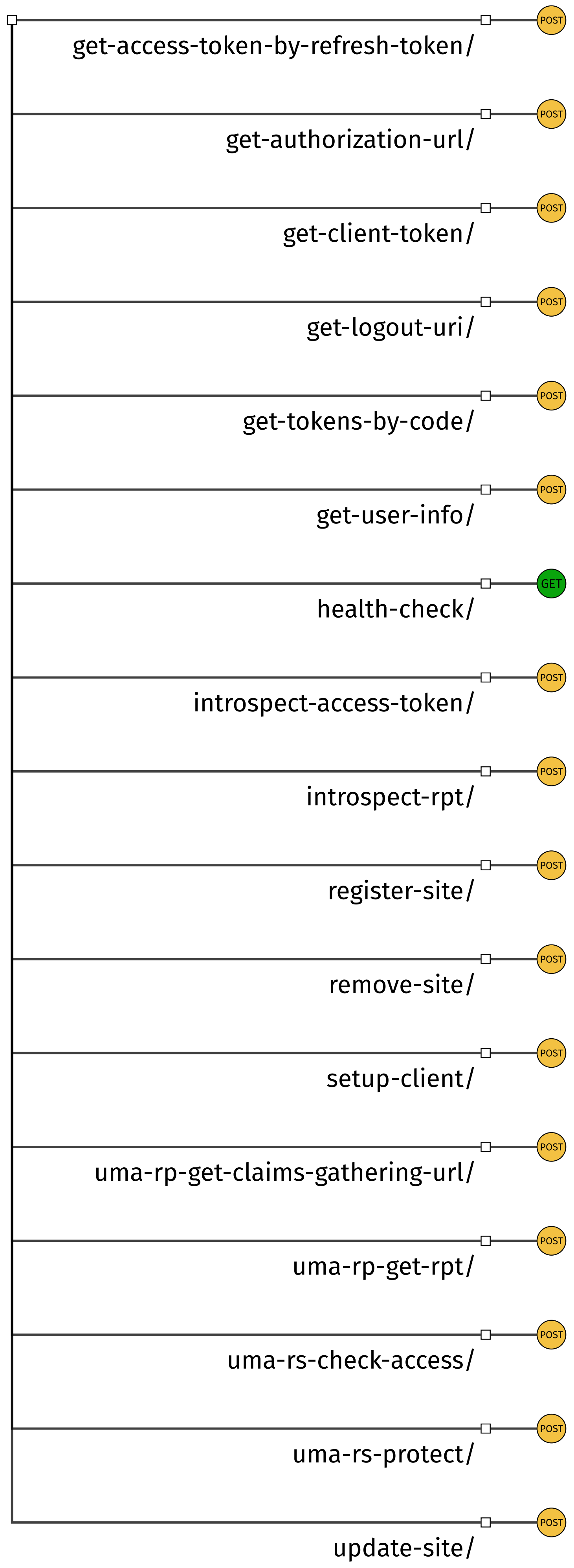
GOXD
beta

335 Ops

335 Paths



Remote Procedure Call



get-access-token-by-refresh-token/ POST

get-authorization-url/ POST

get-client-token/ POST

get-logout-uri/ POST

get-tokens-by-code/ POST

get-user-info/ POST

health-check/ GET

introspect-access-token/ POST

introspect-rpt/ POST

register-site/ POST

remove-site/ POST

setup-client/ POST

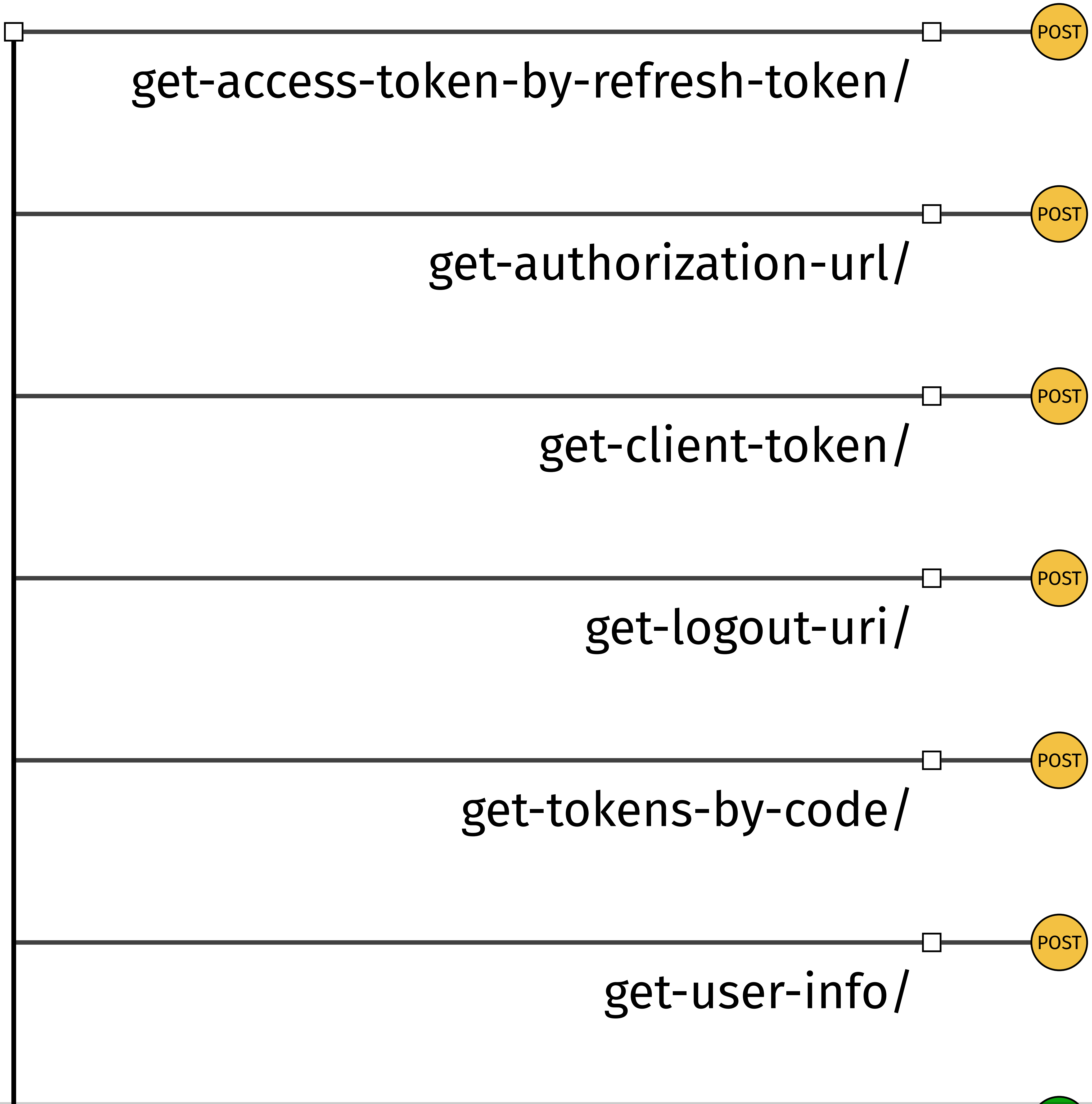
uma-rp-get-claims-gathering-url/ POST

uma-rp-get-rpt/ POST

uma-rs-check-access/ POST

uma-rs-protect/ POST

update-site/ POST



get-access-token-by-refresh-token/ POST

get-authorization-url/ POST

get-client-token/ POST

get-logout-uri/ POST

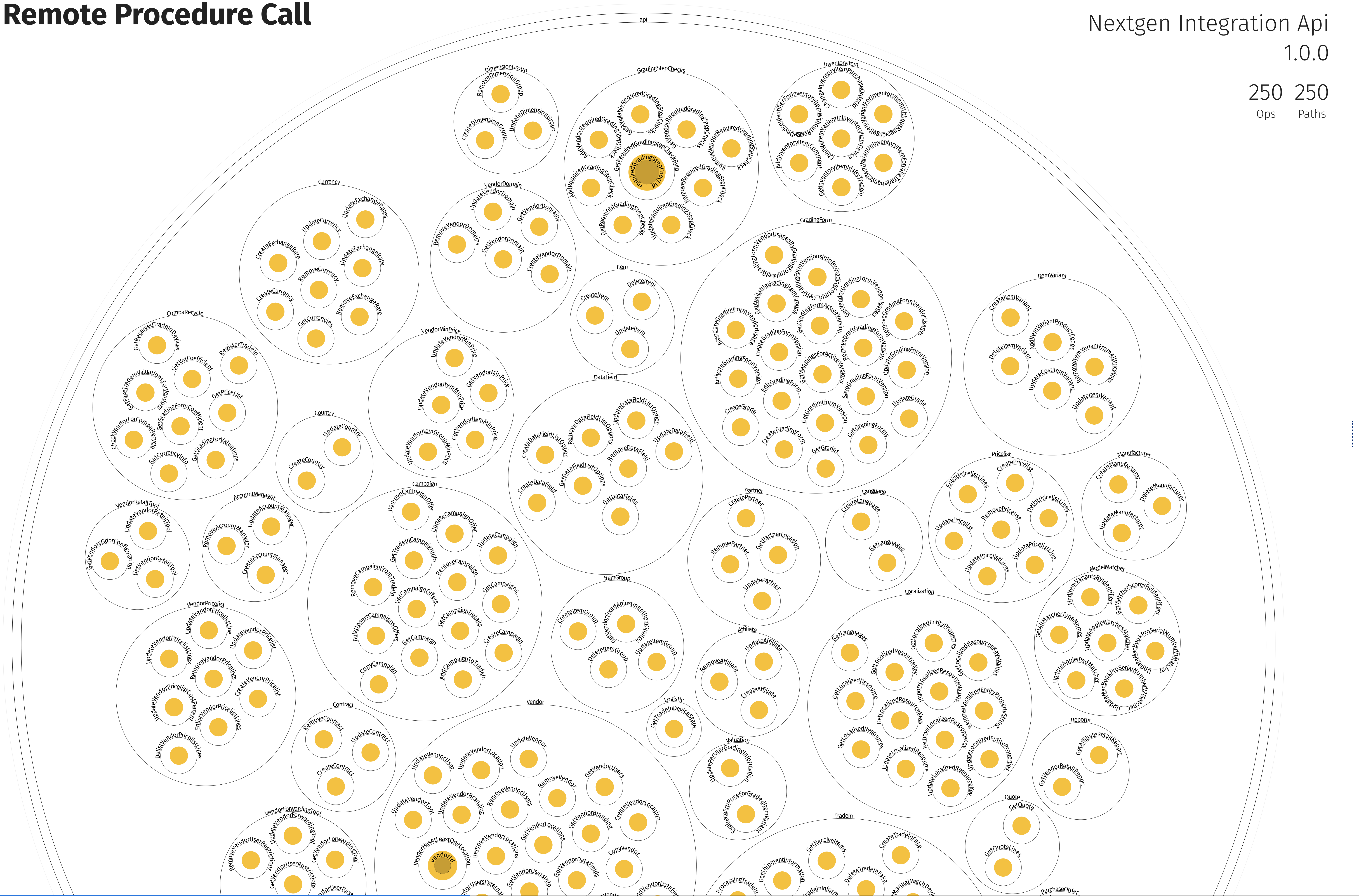
get-tokens-by-code/ POST

get-user-info/ POST

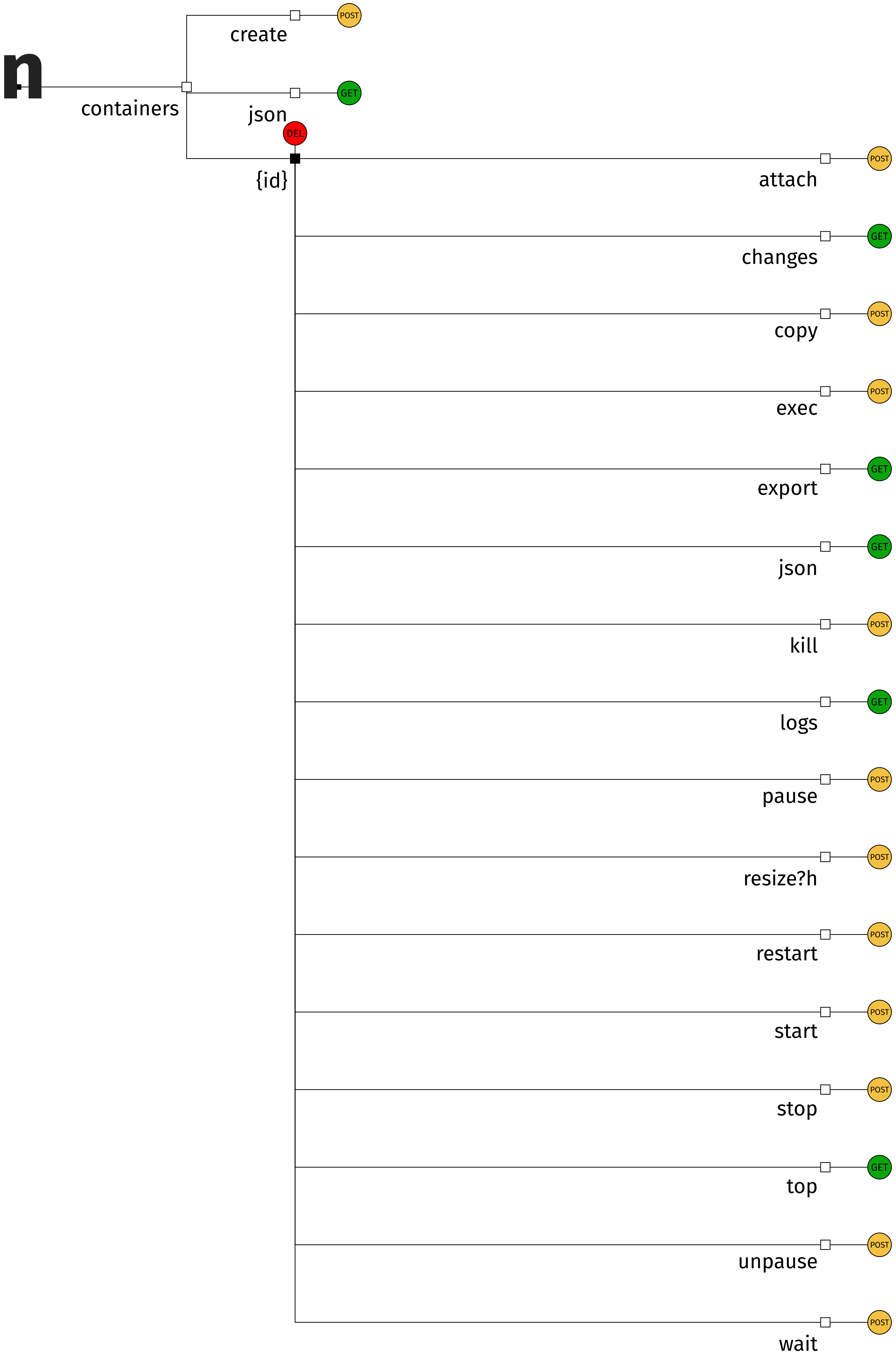
Remote Procedure Call

Nextgen Integration Api
1.0.0

250 Ops 250 Paths

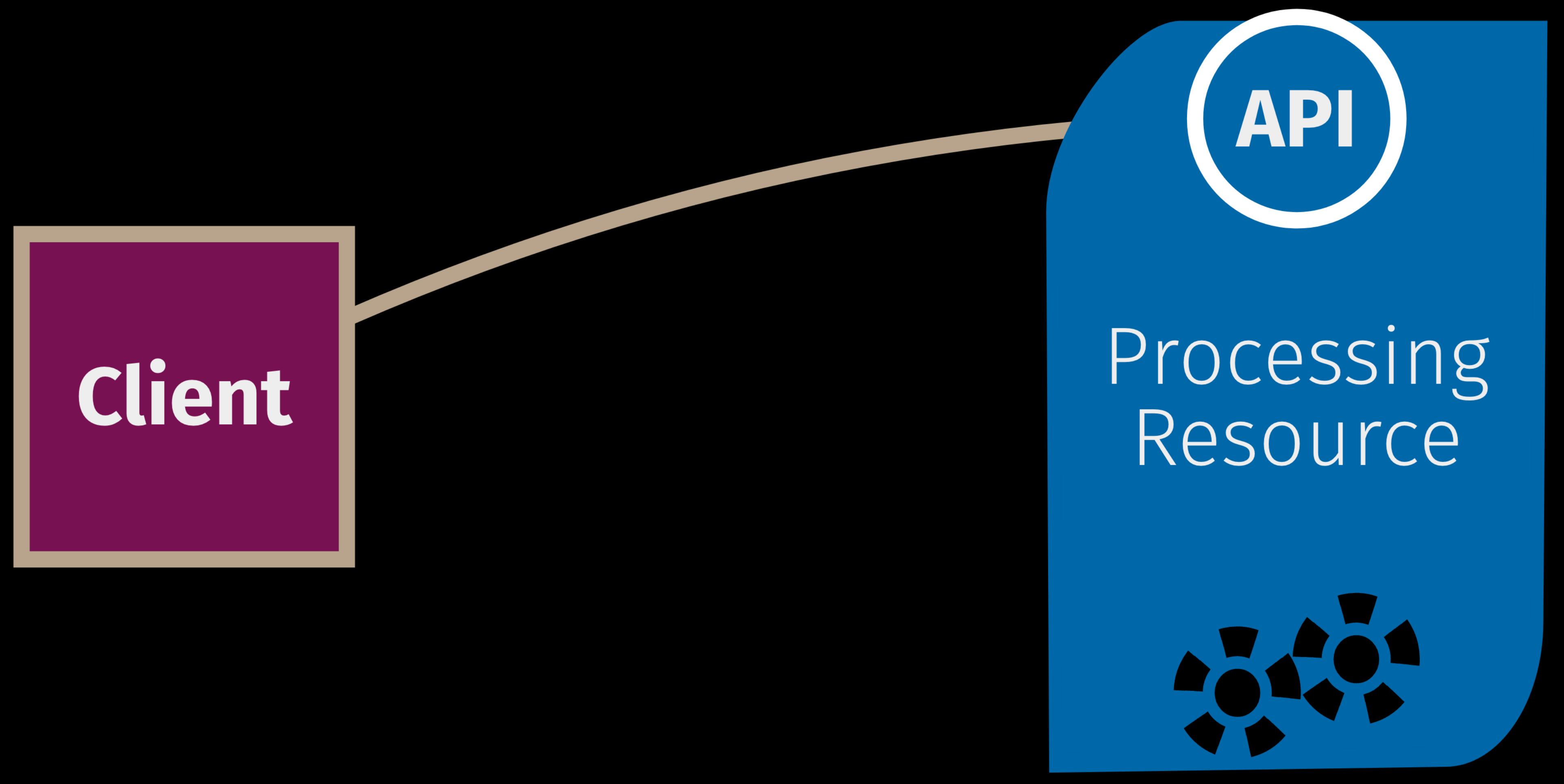


METHOD .../action



Processing Resource

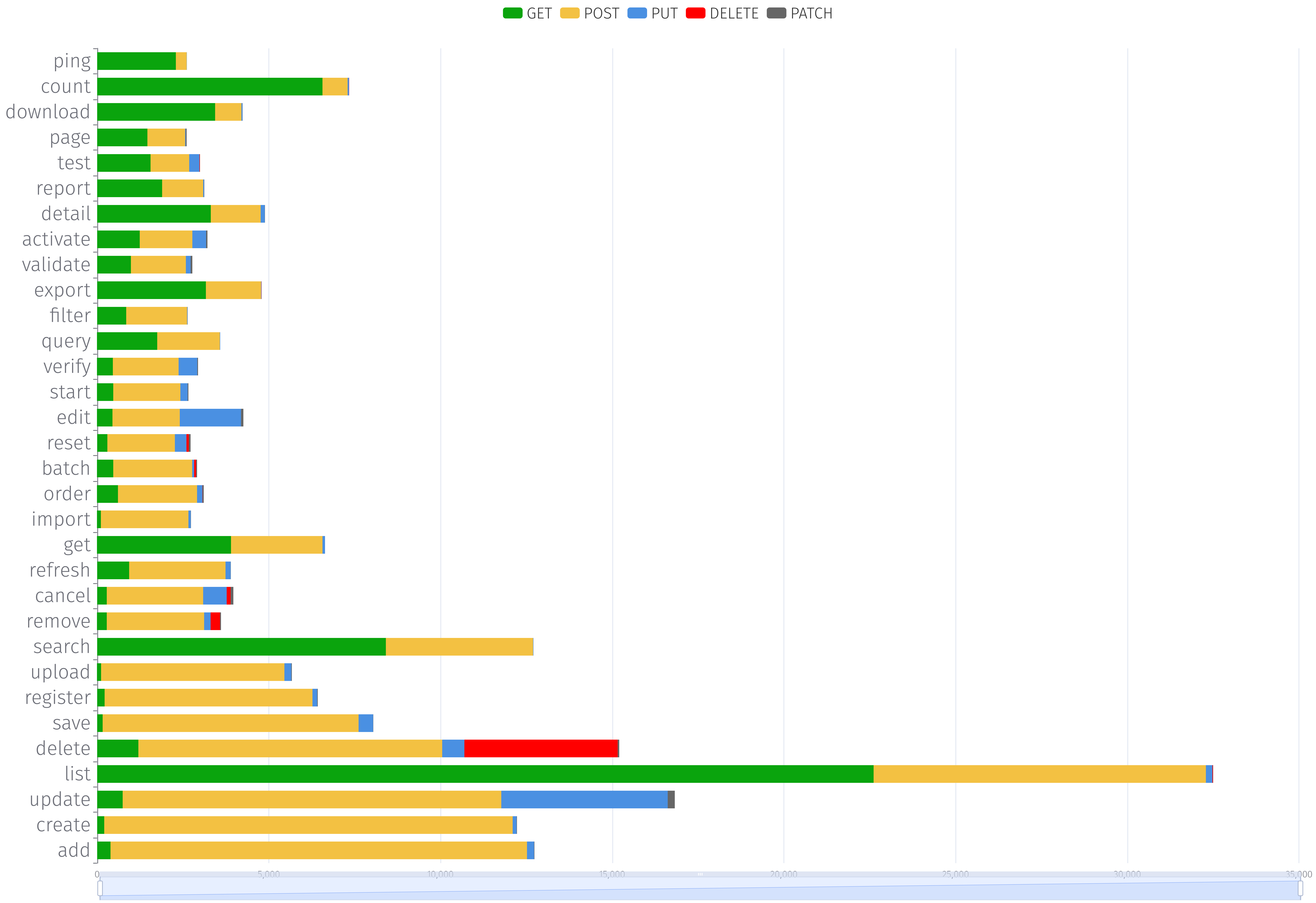
How can an API provider allow its remote clients to trigger actions in it?



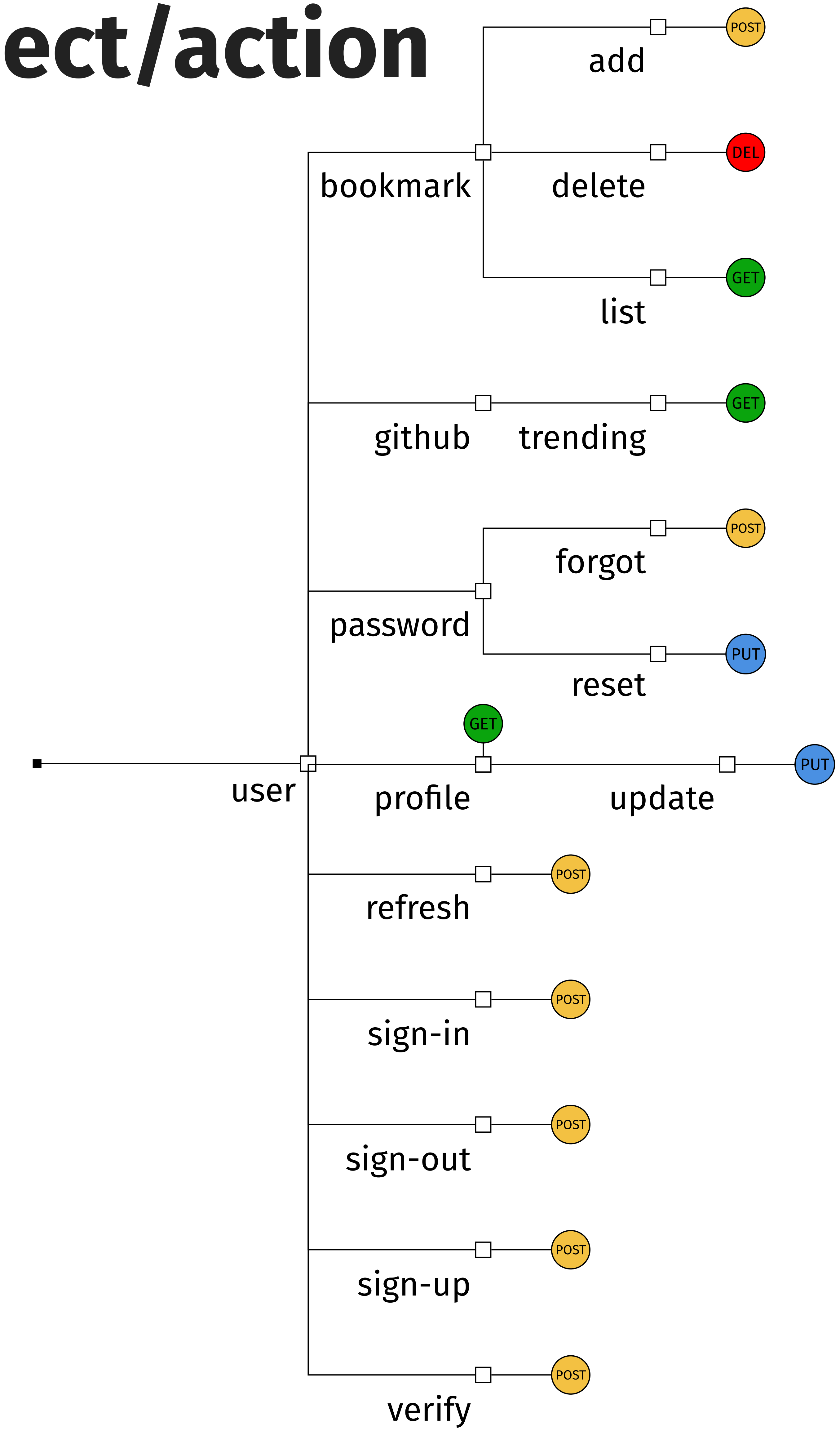
Actions → Methods

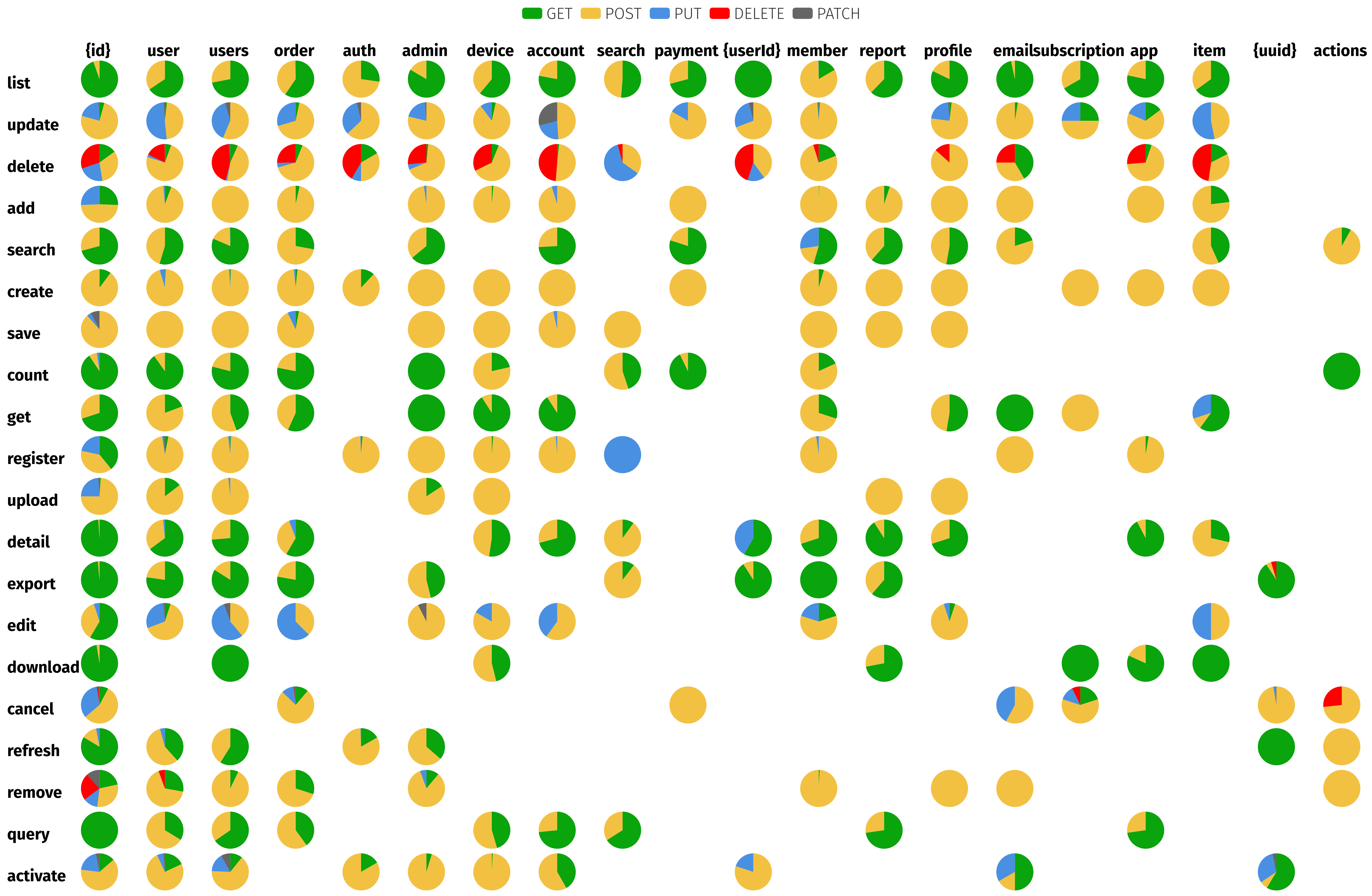
list, update, delete, add, search, create, save, count, get, register, upload, detail, export, edit, download, cancel, refresh, remove, query, activate, report, order, test, verify, batch, validate, import, reset, start, filter, ping, page, send, check, view, profile, confirm, state, bulk, disable, email, enable, preview, account, submit, sync, scheme, finish, insert, request, archive, authenticate, index, invite, inventory, score, deactivate, image, notify, stop, publish, log, comment, read, revoke, file, find, approve, change, last, content, audit, complete, snooze, accept, set, contour, range, generate, message, copy, close, grant, apply, run, refund, address, modify, reject, restore, clone, project, default, excel, contact, install, balance, name, restart, subscribe, result, group, trace, clear, pay, move, map, code, process, push, share, tree, ticket, traffic, schedule, resume, post, type, sign, pause, control, assign, issue, finalize, unlock, discover, catalog, lock, join, paginate, review, like, fetch, authorize, replace, select, execute, load, decline, phone, home, rename, dump, tag, transfer, calculate, resolve, stream, top, open, total, document, merge, invoice, form, alert, link, purchase, bind, connect, feed, show, google, record, trigger, reorder, key, reboot, card, charge, withdraw, store, duplicate, cache, block, source, action, swagger, release, time, terminate, task, campaign, commit, redeem, team, put, service, receive,

GET,
POST,
PUT,
DELETE,
PATCH,
OPTIONS


GET
POST
PUT
DELETE
PATCH
ping
count
download
page
test
report
detail
activate
validate
export
filter
query
verify
start
edit
reset
batch
order
import
get
refresh
cancel
remove
search
upload
register
save
delete
list
update
create
add
0
5,000
10,000
15,000
20,000
25,000
30,000
35,000

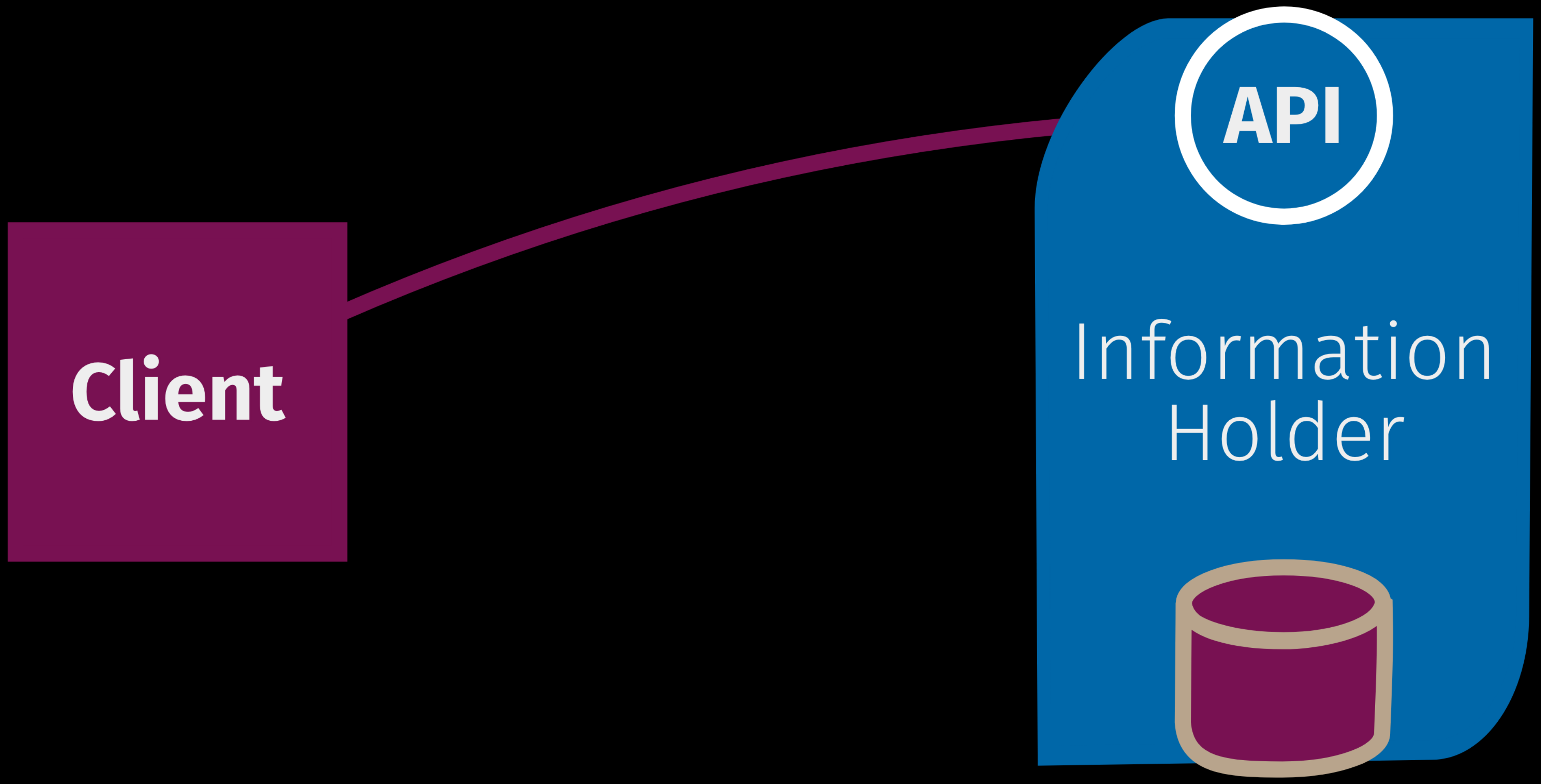
METHOD .../object/action



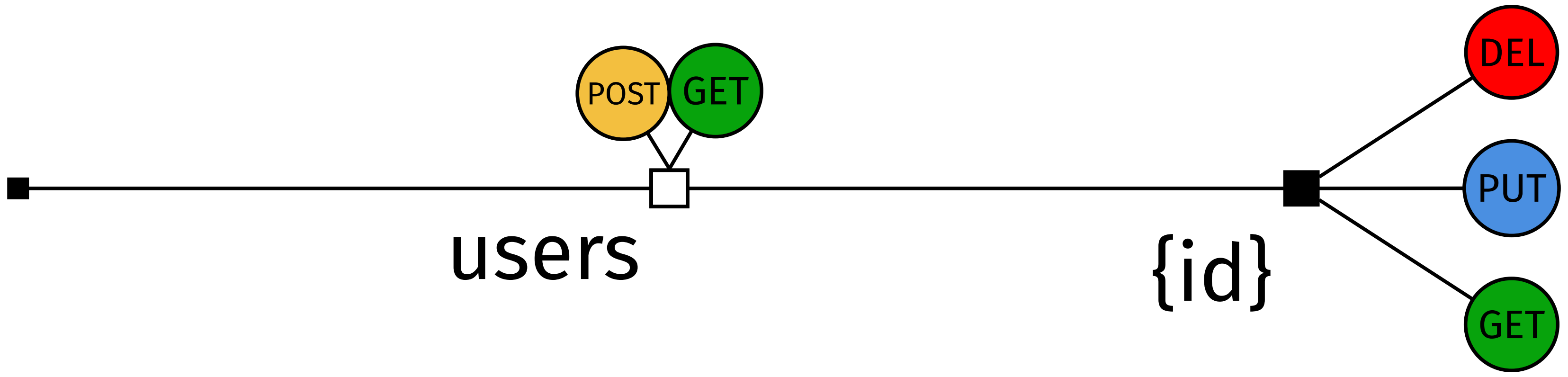

GET
POST
PUT
DELETE
PATCH
{id}
user
users
order
auth
admin
device
account
search
payment
{userId}
member
report
profile
email
subscription
app
item
{uuid}
actions
list
update
delete
add
search
create
save
count
get
register
upload
detail
export
edit
download
cancel
refresh
remove
query
activate

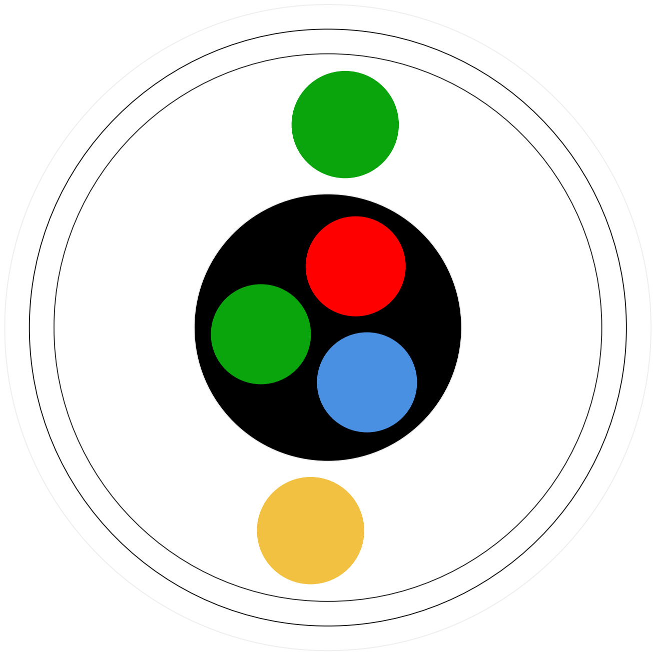
Information Holder

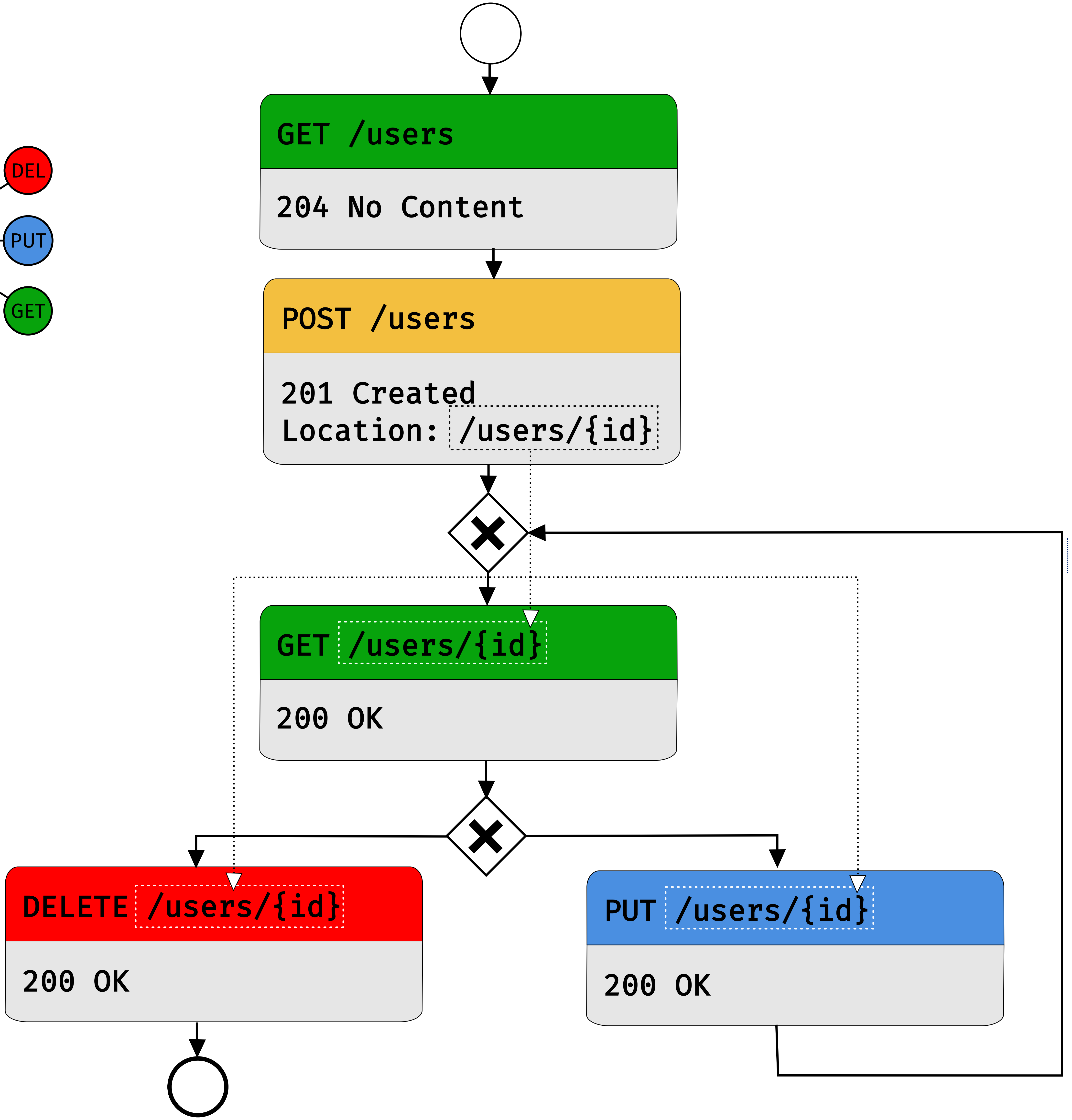
How can an API expose data entities so that API clients can access and/or modify these entities concurrently without compromising data integrity and quality?



Collection







GET /users

204 No Content

POST /users

201 Created
Location: /users/{id}

GET /users/{id}

200 OK

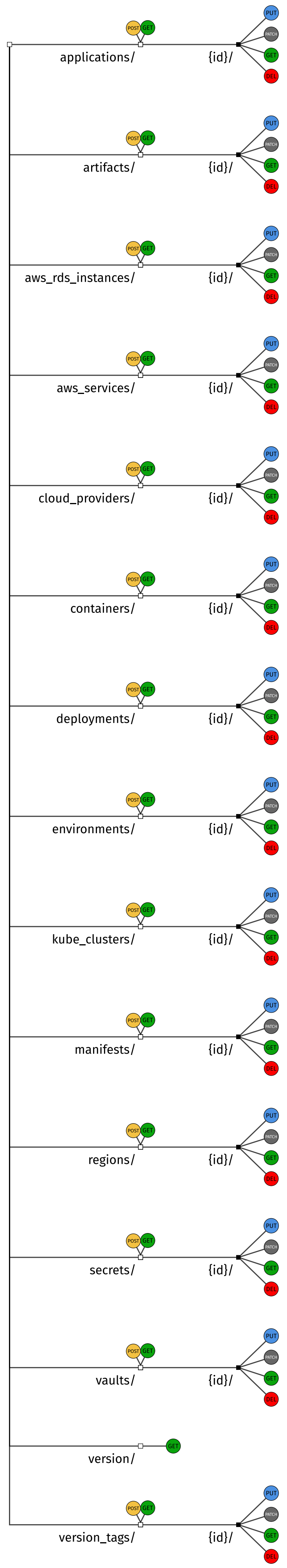
DELETE /users/{id}

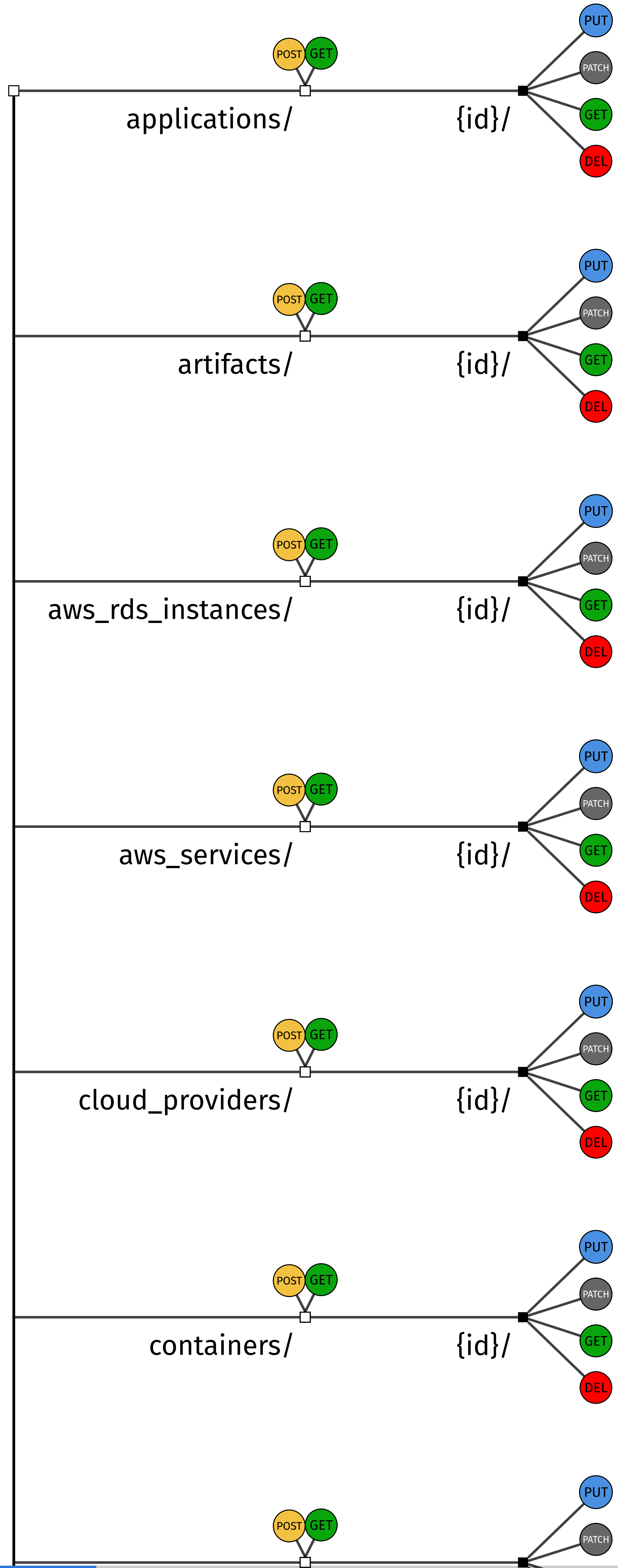
200 OK

PUT /users/{id}

200 OK

Collections



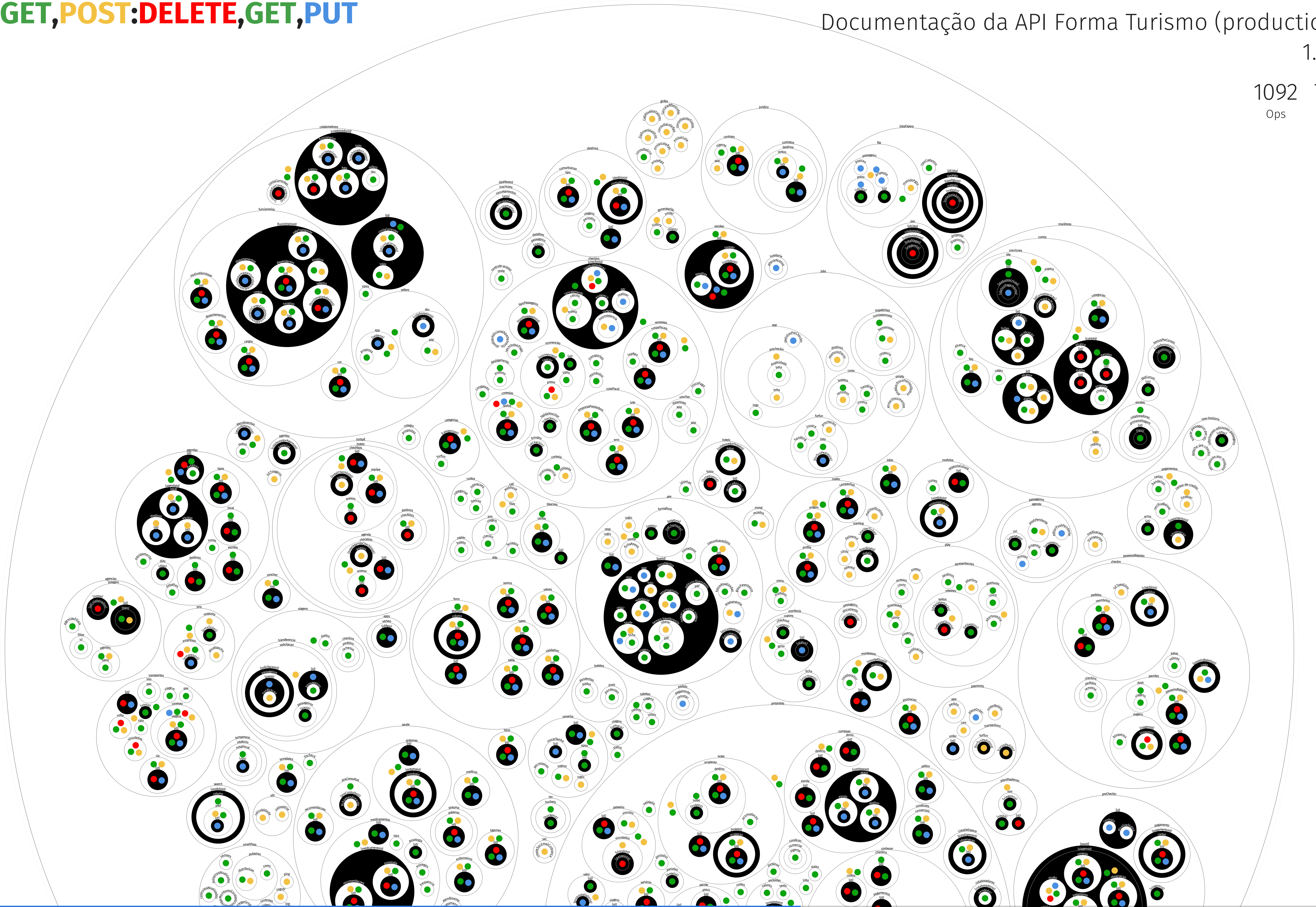


GET,POST:DELETE,GET,PUT

Documentação da API Forma Turismo (production)

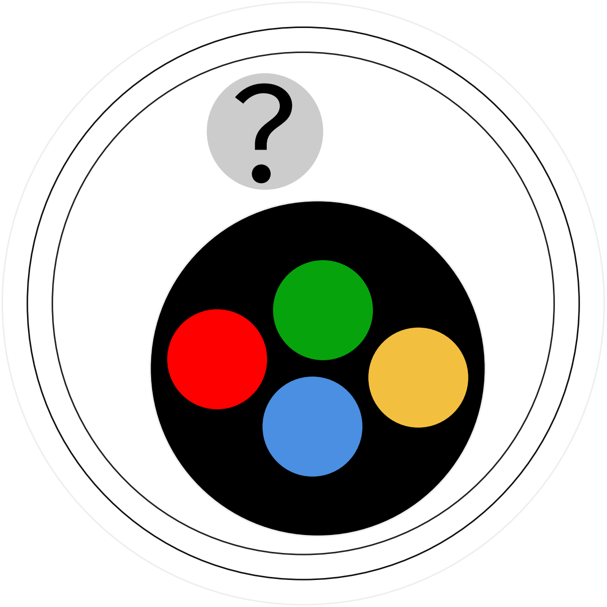
1.6.7

1092	719
Ops	Paths

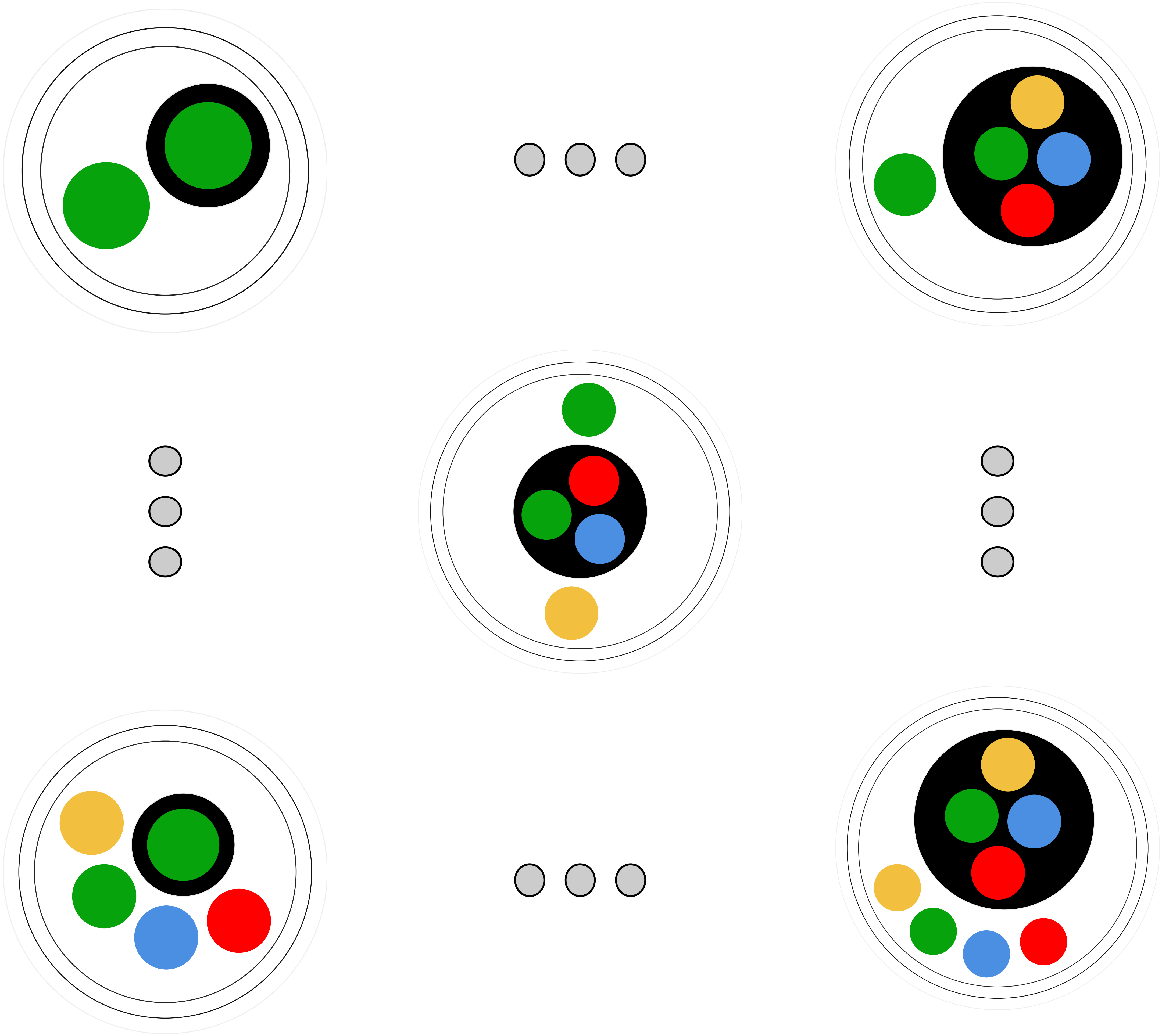


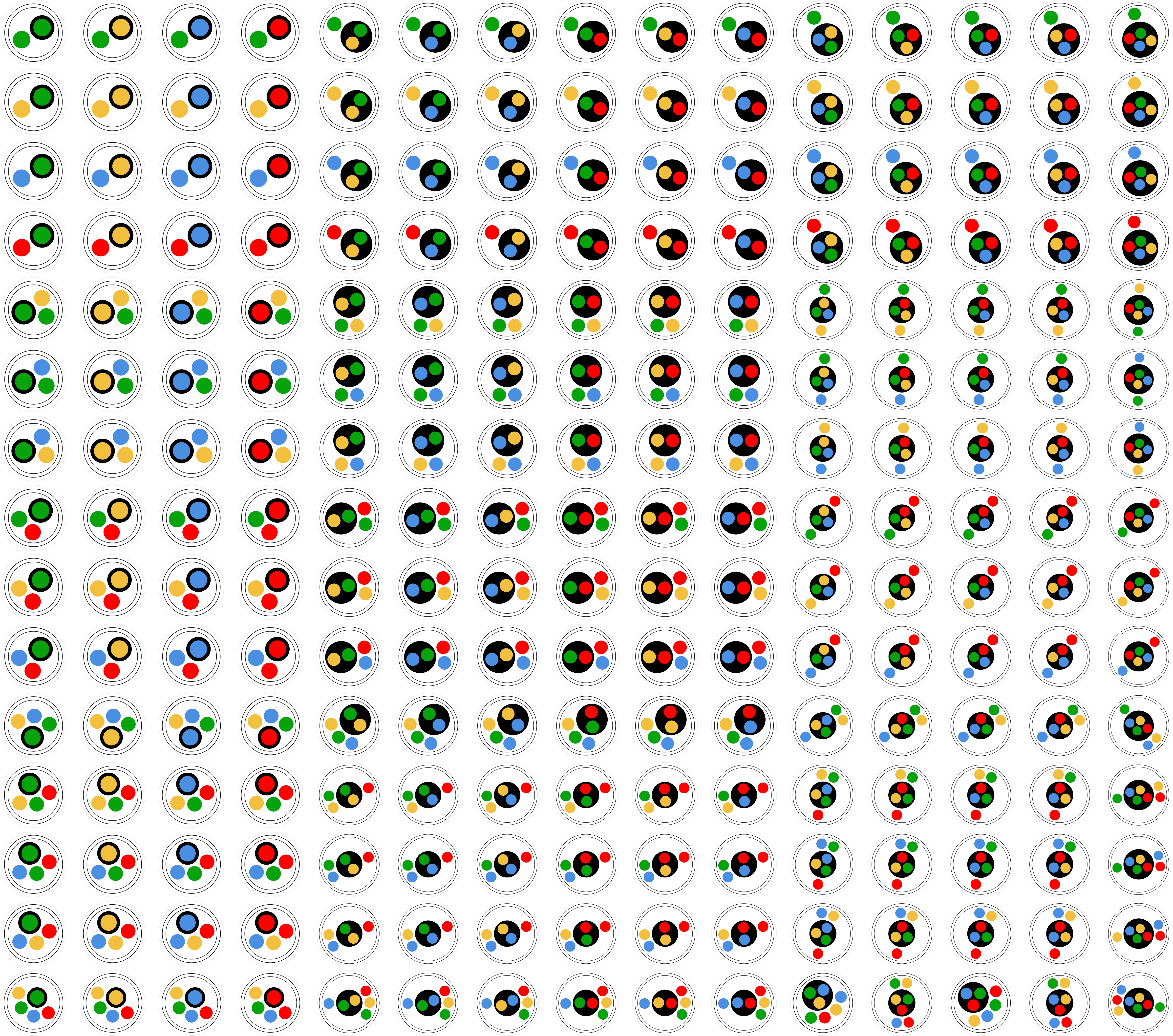
Container methods

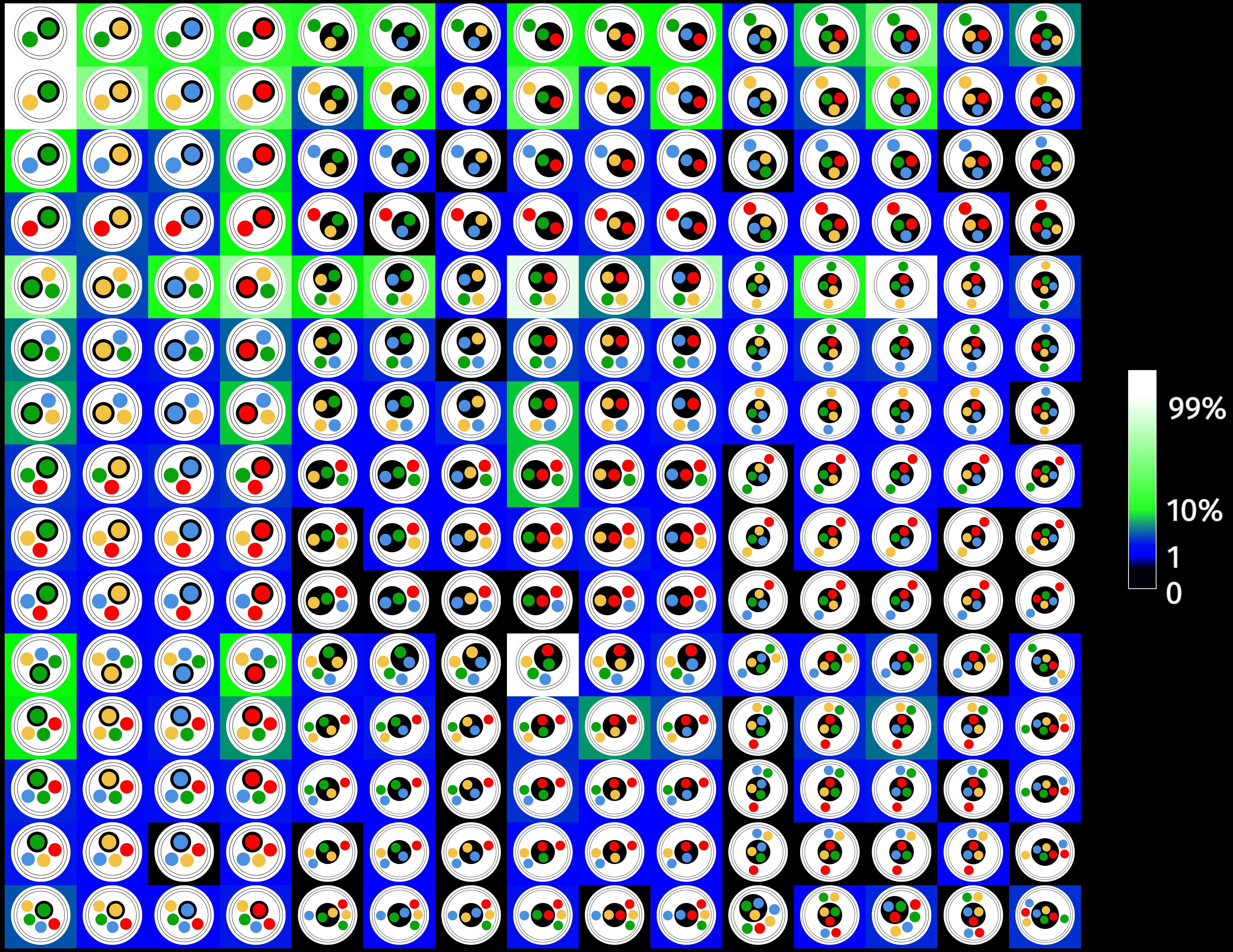
×

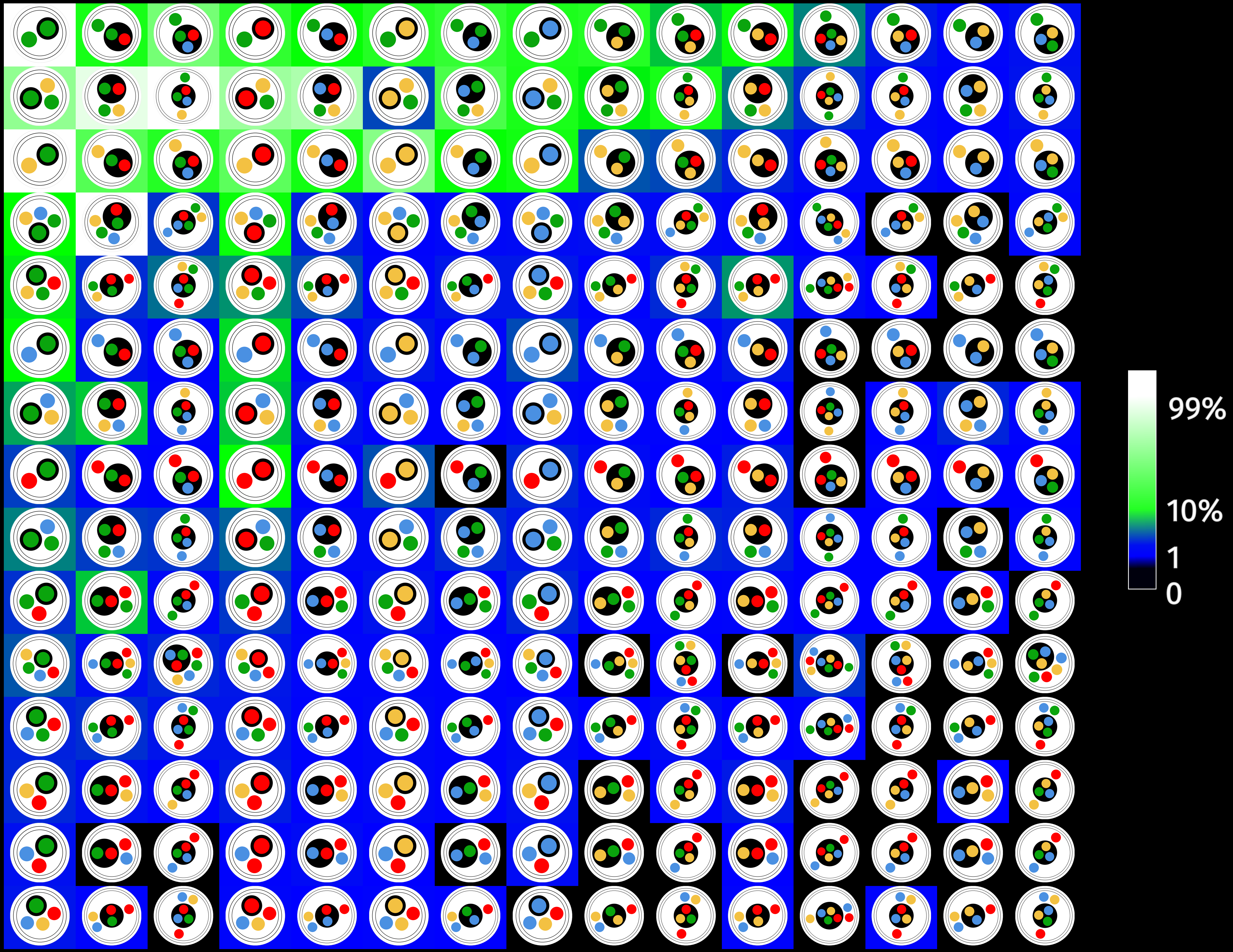


Item methods

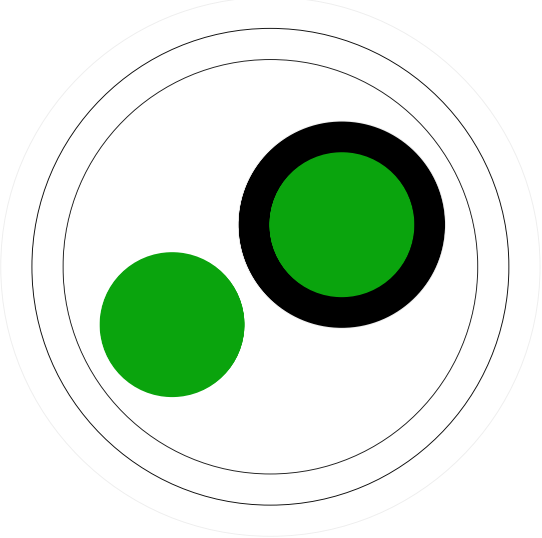


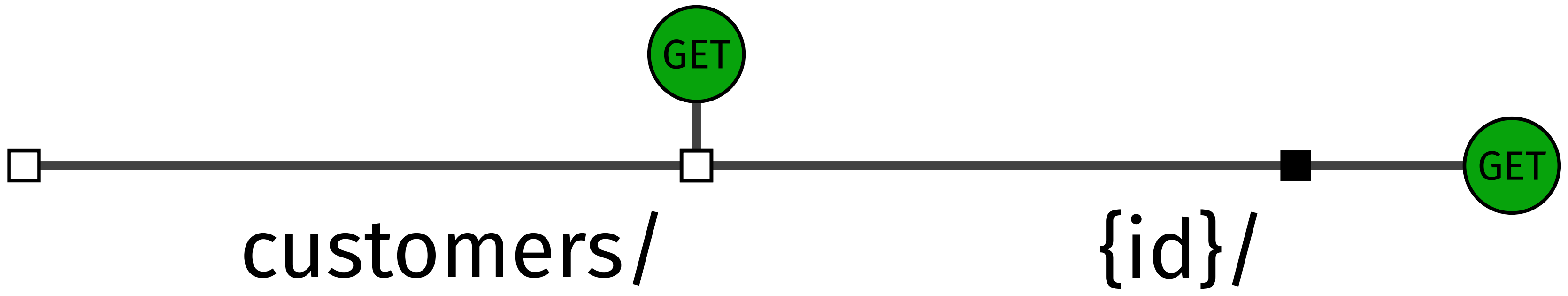


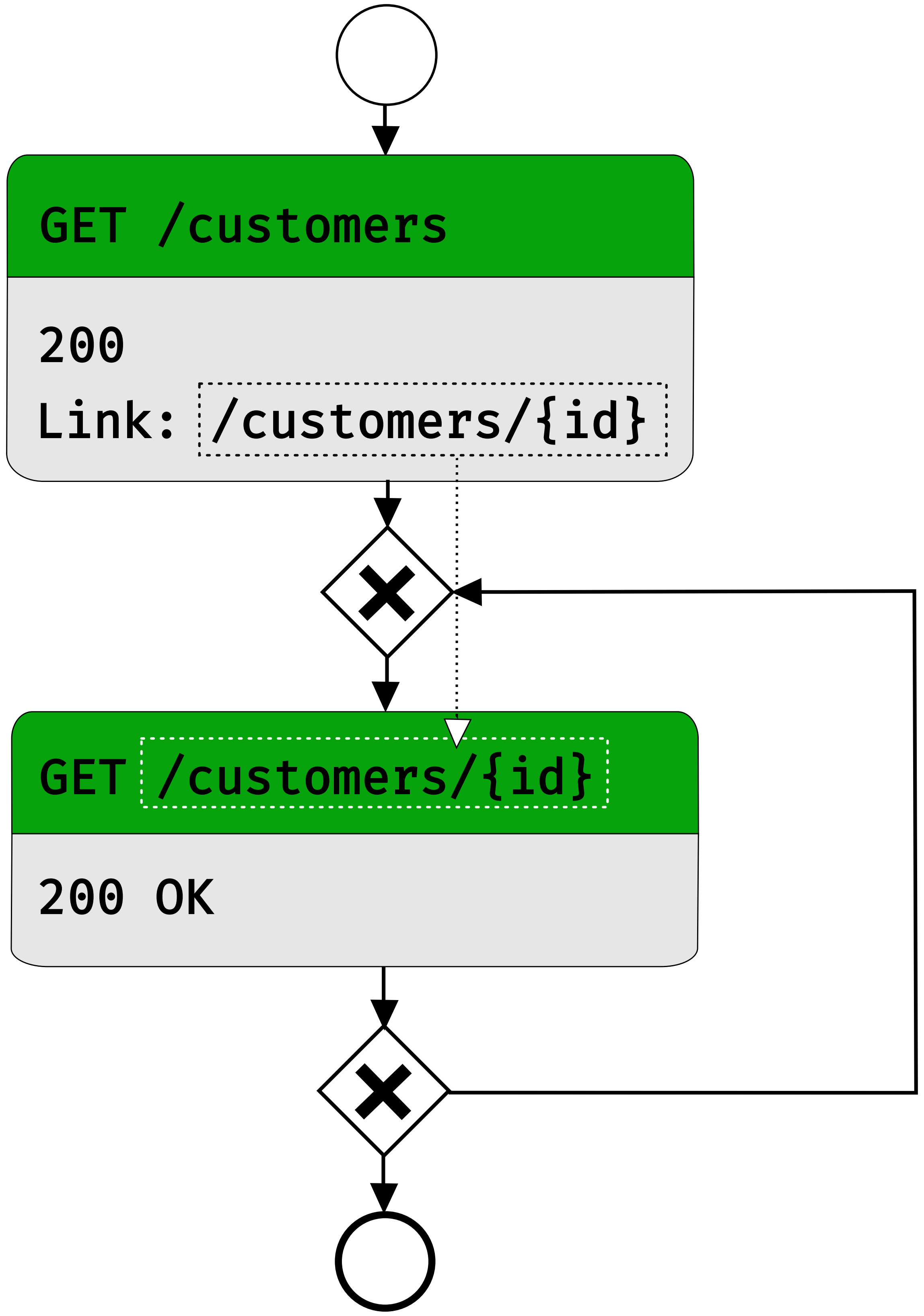

99%
10%
1
0


99%
10%
1
0

Read-Only Collection





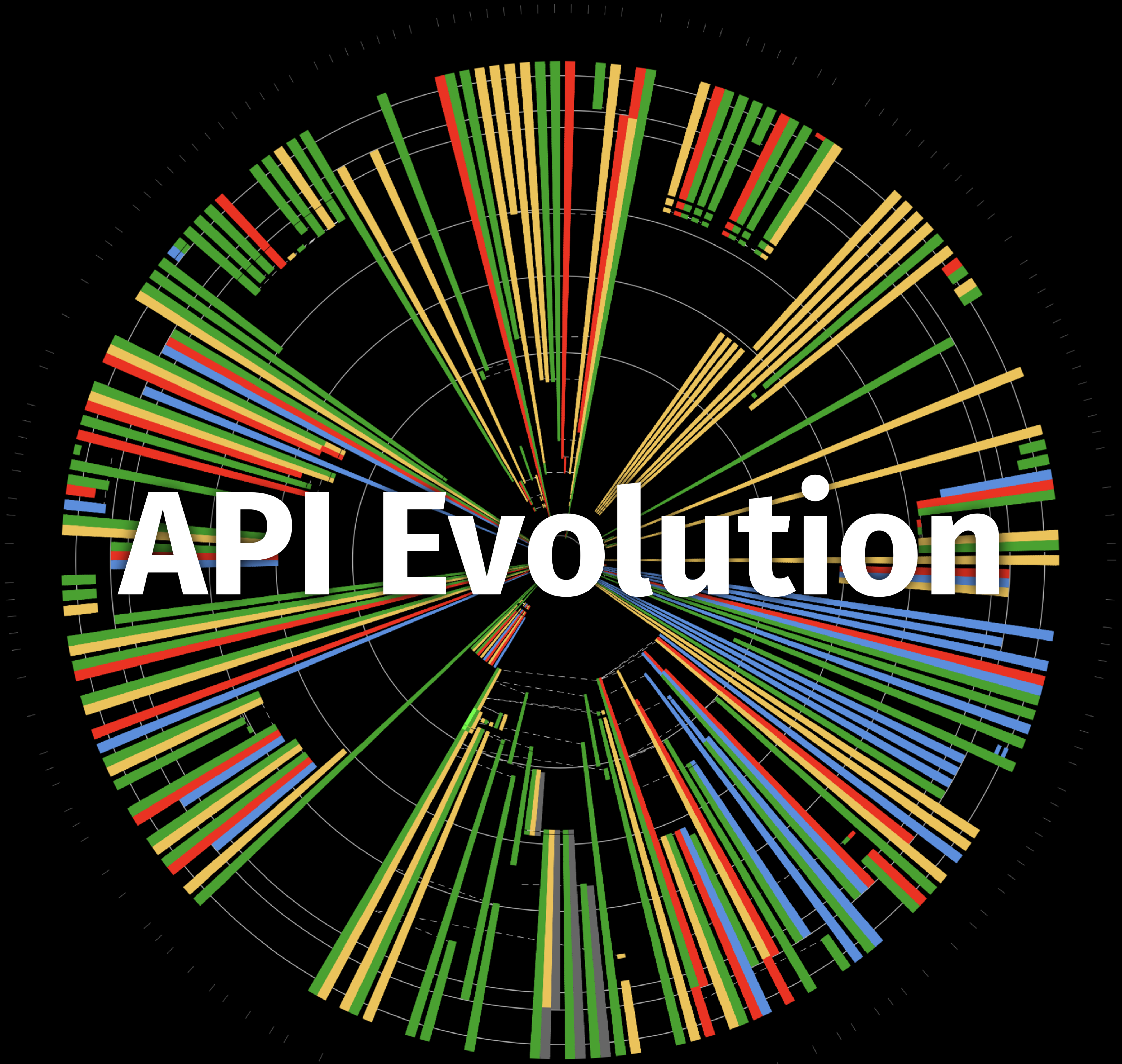


GET /customers

200
Link: /customers/{id}

GET /customers/{id}

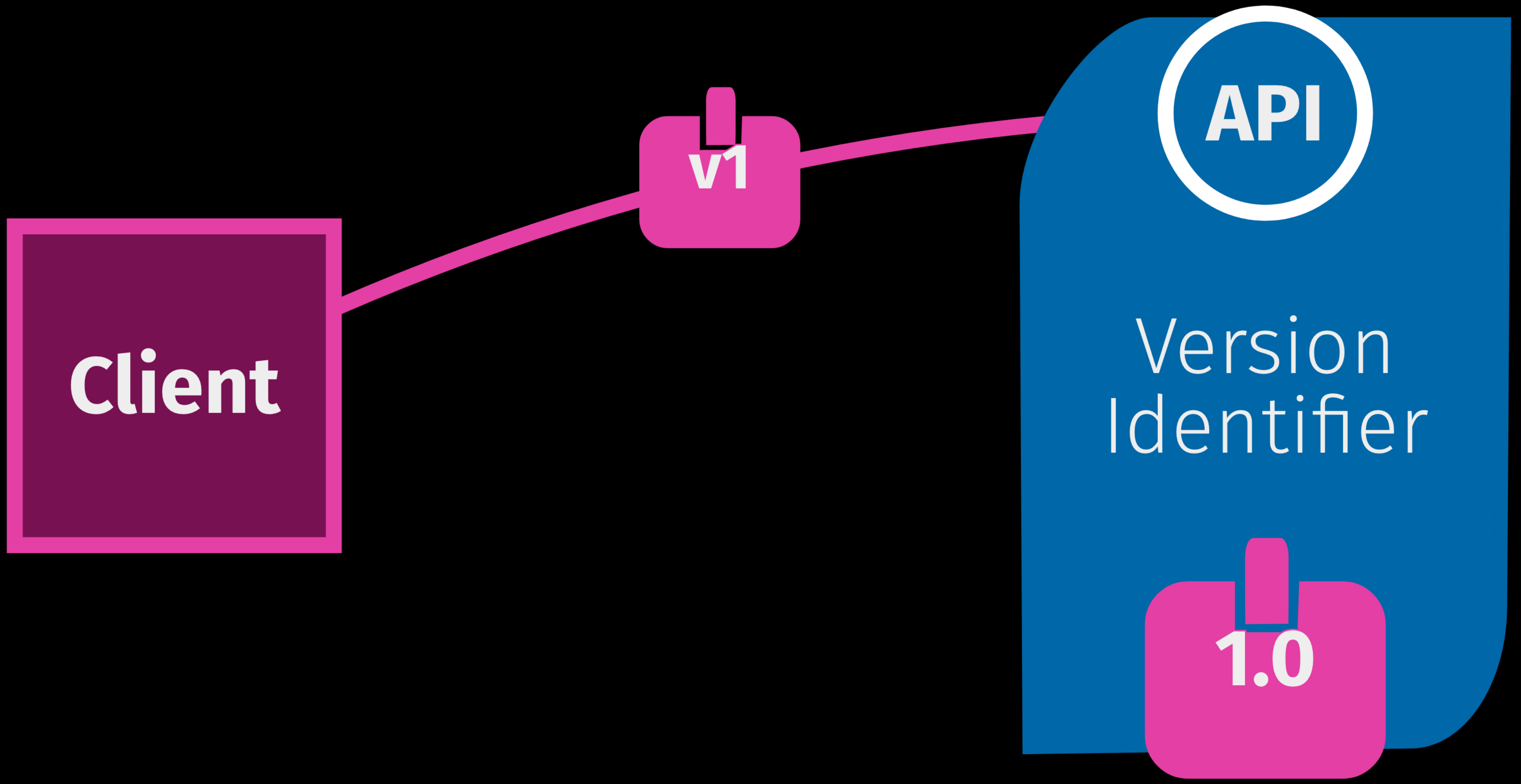
200 OK



API Evolution

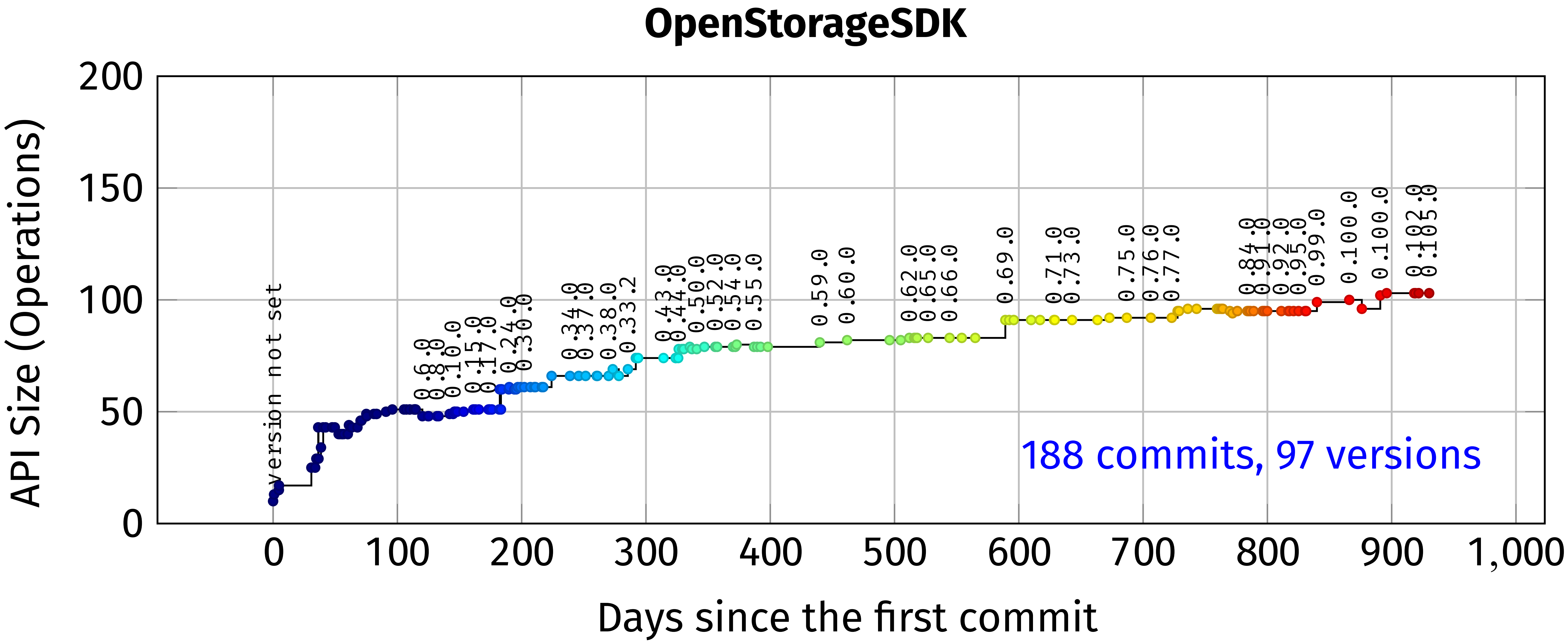
Version Identifier

How can an API provider indicate its current capabilities as well as the existence of possibly incompatible changes to clients, in order to prevent malfunctioning of clients due to undiscovered interpretation errors?



Version Identifier

Metadata



Version Identifier

Metadata

`1.0 1.0.0 v1 0.0.1 undefined "version not set" 2.0 0.1 v2 0.1.0 1.0.1 2.0.0 1.1.0 v1.0 3.0 0.1.0-SNAPSHOT 0.0.1-SNAPSHOT beta 3.0.0 1.1 1.0.0-SNAPSHOT 3.0.2 1.0.2 1.2.0 unversioned v3 0.0.0 0.2.0 2015-11-01 v1.0.0 V1 v0.11 2018-06-01-preview 1.0-SNAPSHOT 2019-08-01 v1.7.0 版本号:1.0.0 3.0.1 2019-07-01 V1.0 0.0.2 2019-06-01 2019-01-01 API V1.0 v0.1 2016-05-01 4.0.0 master 2014-04-01 2018-02-01 2019-04-01 1.0.5 v1.8.0 2018-01-01 2017-10-01 2019-12-01-preview 1.0.3 1.3.0 v0 v1beta1 0.0.3 0.1.1 2018-06-01 版本号:2.3.0 v1.6.0 2018-10-01 2017-03-01-preview 1.0.4 1.4.0 M1 0.2 1.1.1 2.0.1 版本号:1.0 1.5 V0.0.1 v0.0.1 2017-03-01 2018-07-01 1.1.3`

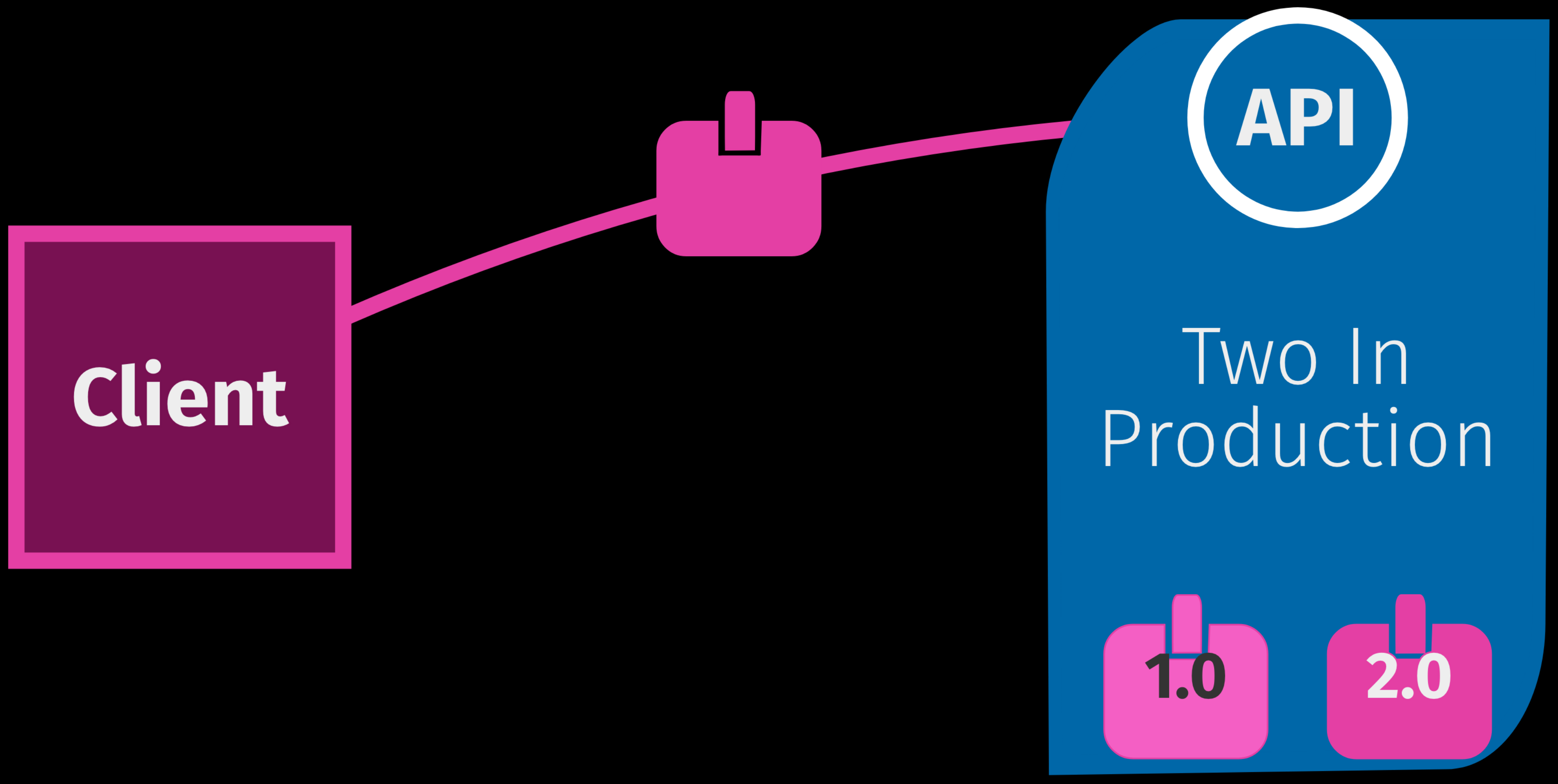
Version Identifier

First Path Segment

`v1 v2 v1.0 v3 v4 v2.0 v9 v8 v0 v1.1 v0.1 v{version} V1 v{VERSION_NBR} v2.1 v1.2 v0.2 v{apiVersion} V1.0 v5 v1.3 v{ver} V3 v001 {v} v300 V2 v{api-version} v7 v3.0 v0.3 v2020 favicon_v{v}.ico v6 v20180820 v20190125 v01 v11 {api.v1.prefix} v1.4 v3.5 v{1} V4 v1.5 v2.2 v1.6 v3.3 v0.4 v0.11 v20 v0.9 v1.{output_format} v7.0 v03 V2 V5 V6 v2 v1{image_folder} v360 v20170314 V20161128 v20160101 V20170117 V20190624 v20180301 V3 v20180227 V20150921 V2016 V20180706 V2015 v20140515 v20131101 v1.56 V20141113`

Two in Production

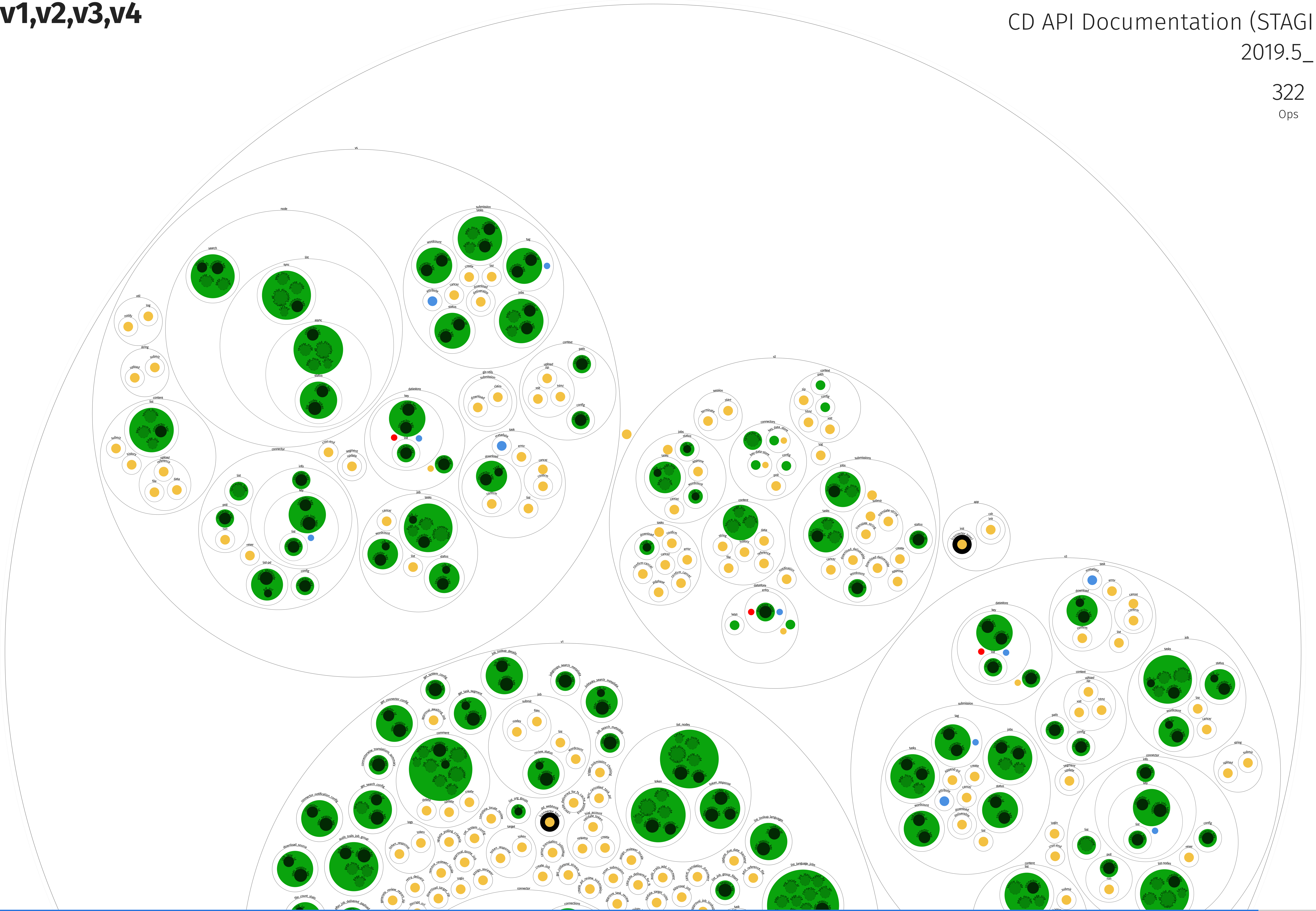
How can a provider gradually update an API without breaking existing clients, but also without having to maintain a large number of API versions in production?



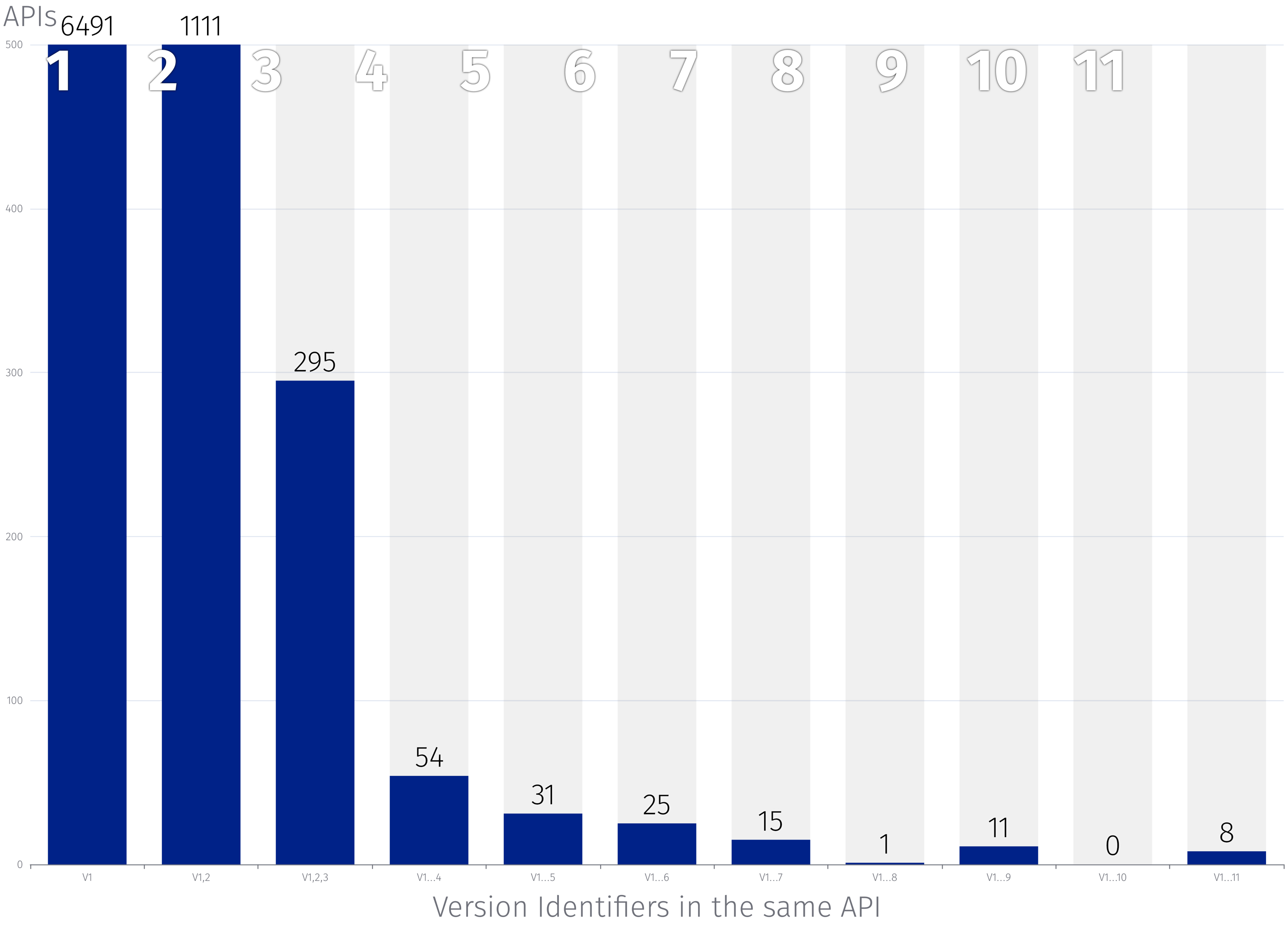
v1,v2,v3,v4

CD API Documentation (STAGING)
2019.5_RC2

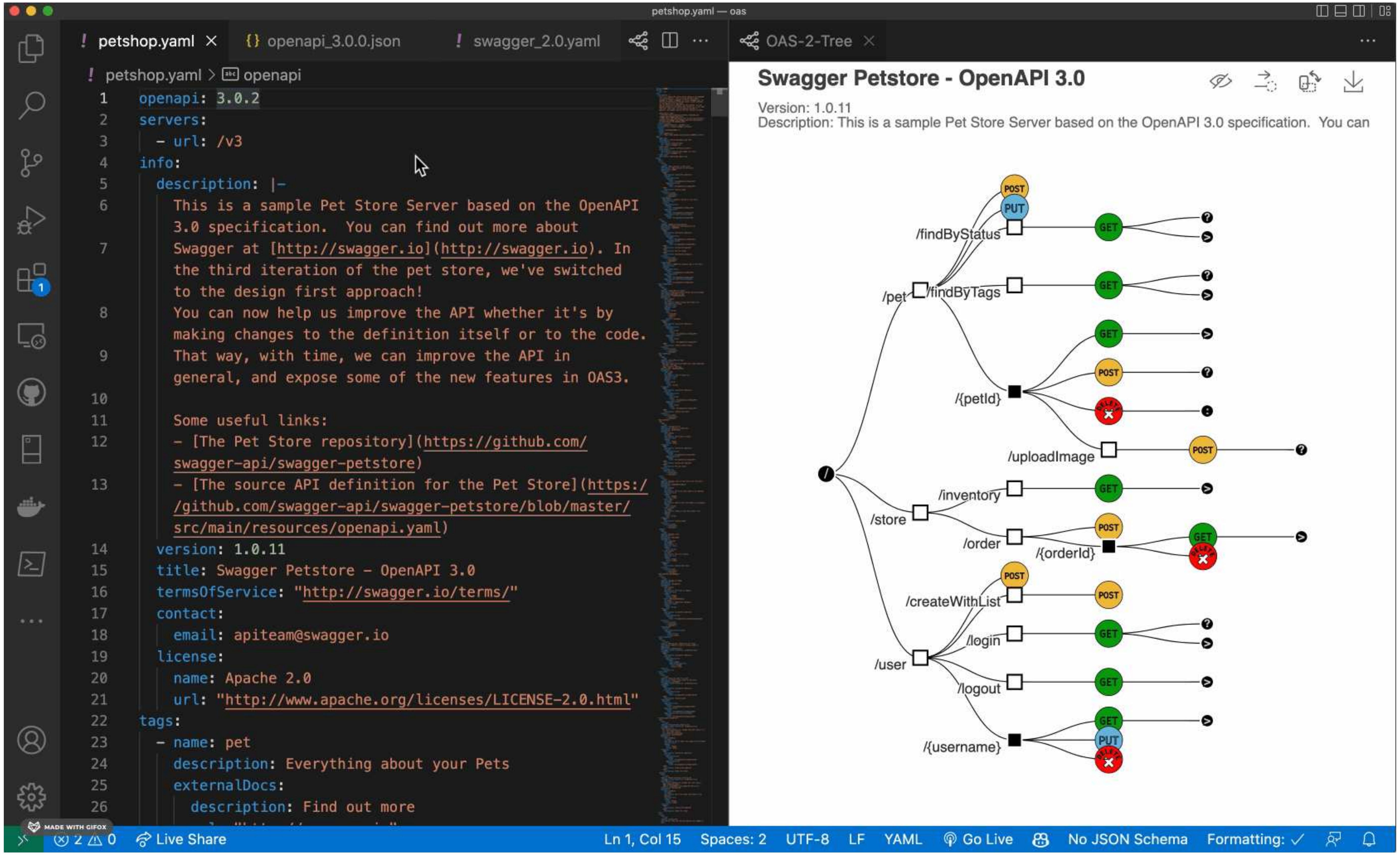
322 Ops
307 Paths



Two in Production



API Visualization Tool: OAS2Tree



```yaml
openapi: 3.0.2
servers:
  - url: /v3
info:
  description: |-
    This is a sample Pet Store Server based on the OpenAPI 3.0 specification.  You can find out more about
    Swagger at [http://swagger.io](http://swagger.io). In the third iteration of the pet store, we've switched to the design first approach!
    You can now help us improve the API whether it's by making changes to the definition itself or to the code.
    That way, with time, we can improve the API in general, and expose some of the new features in OAS3.

    Some useful links:
    - [The Pet Store repository](https://github.com/swagger-api/swagger-petstore)
    - [The source API definition for the Pet Store](https://github.com/swagger-api/swagger-petstore/blob/master/src/main/resources/openapi.yaml)
  version: 1.0.11
  title: Swagger Petstore - OpenAPI 3.0
  termsOfService: "http://swagger.io/terms/"
  contact:
    email: apiteam@swagger.io
  license:
    name: Apache 2.0
    url: "http://www.apache.org/licenses/LICENSE-2.0.html"
tags:
  - name: pet
    description: Everything about your Pets
    externalDocs:
      description: Find out more
```

Swagger Petstore - OpenAPI 3.0

Version: 1.0.11

Description: This is a sample Pet Store Server based on the OpenAPI 3.0 specification. You can

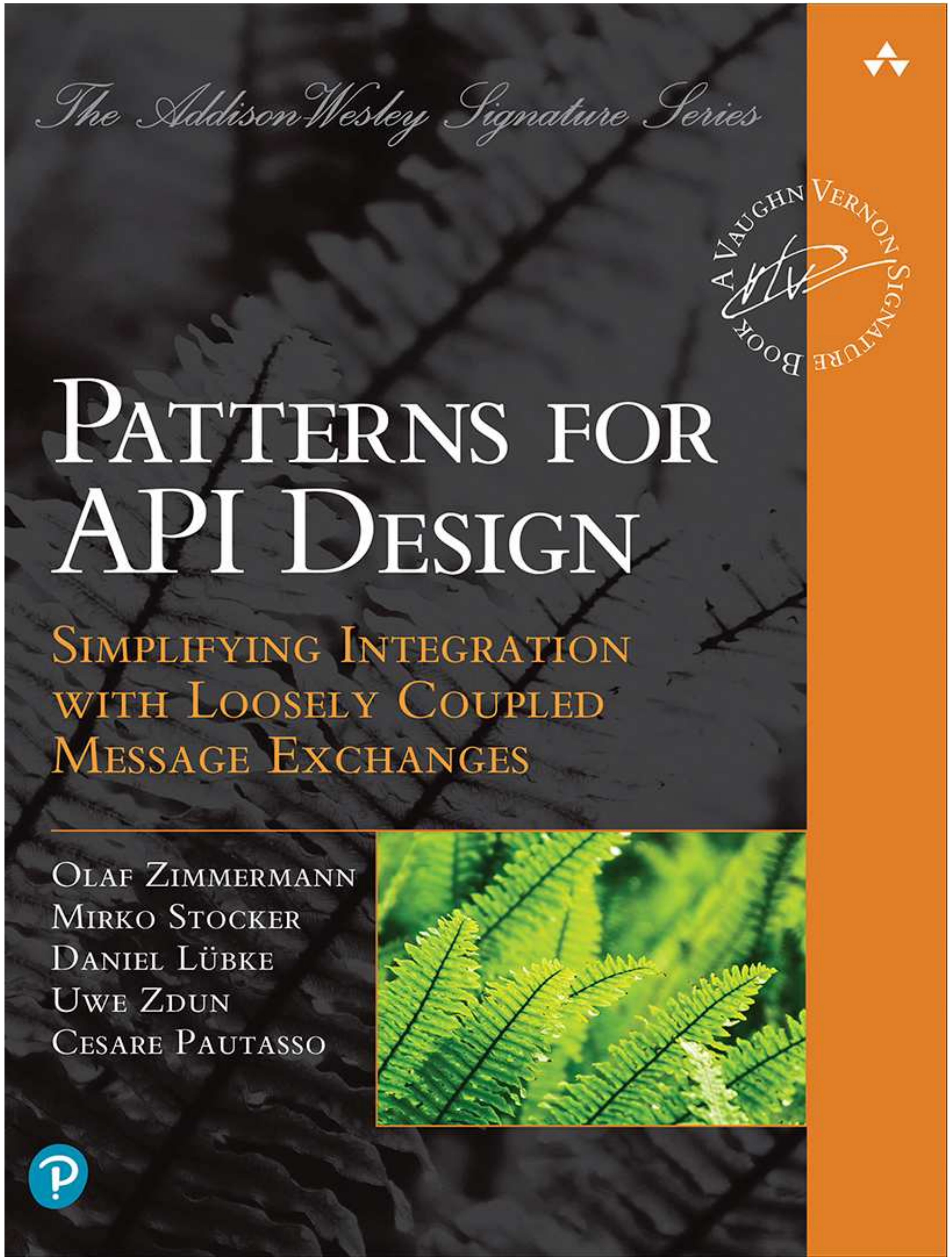
https://marketplace.visualstudio.com/items?itemName=oas2tree.oas2tree

Acknowledgements

Souhaila Serbout, Deepansha Chowdhary, Fabio Di Lauro, Segilola Mustapha, Gustavo Graziani, Albert Walser, Alessandro Romanelli, Ana Ivanchikj, Apitchaka Singjai

Olaf Zimmermann, Uwe Zdun, Daniel Lübke, Mirko Stocker

Erik Wilde, Shubham Shah (Assetnote)


The Addison Wesley Signature Series
A Vaughn Vernon Signature Book
Patterns for API Design
Simplifying Integration with Loosely Coupled Message Exchanges
Olaf Zimmermann
Mirko Stocker
Daniel Lübke
Uwe Zdun
Cesare Pautasso

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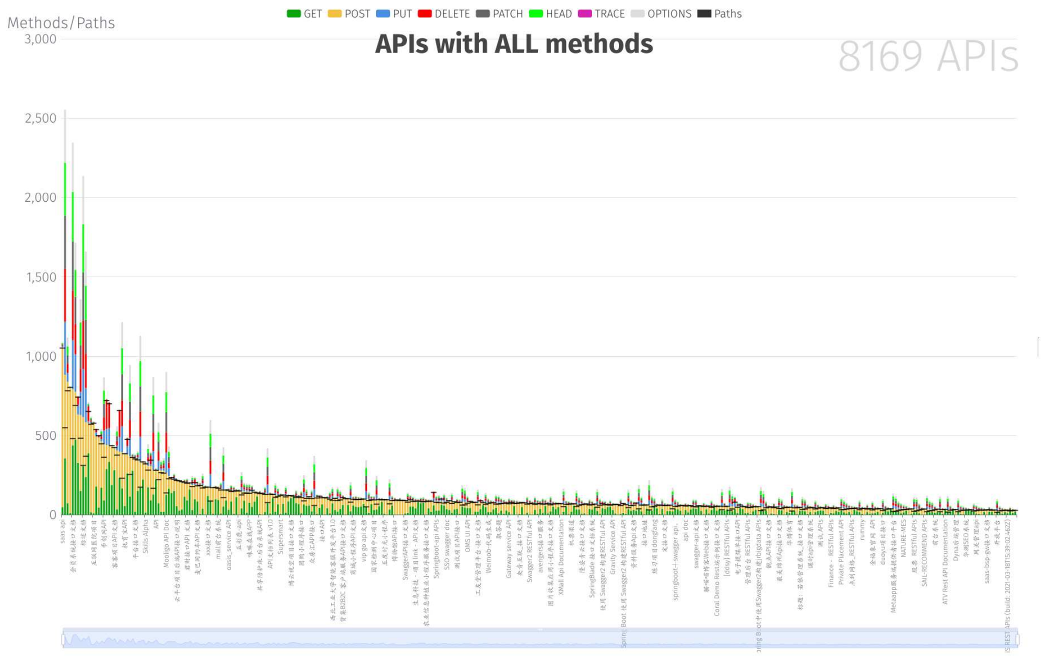
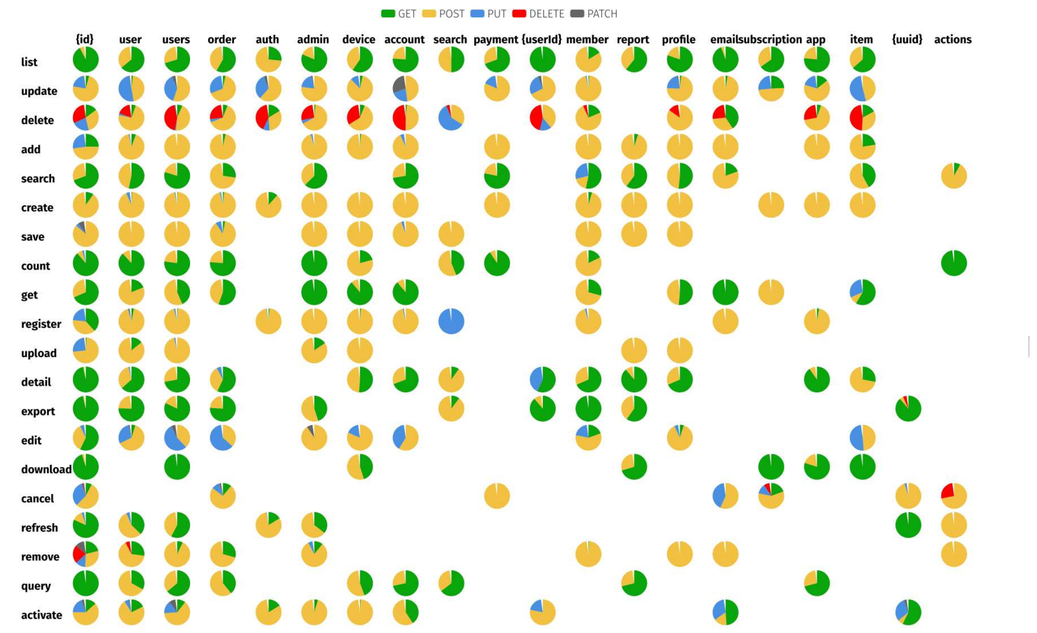
Simplifying Integration with Loosely Coupled Message Exchanges

December 2022
ISBN: 978-0-13767010-9

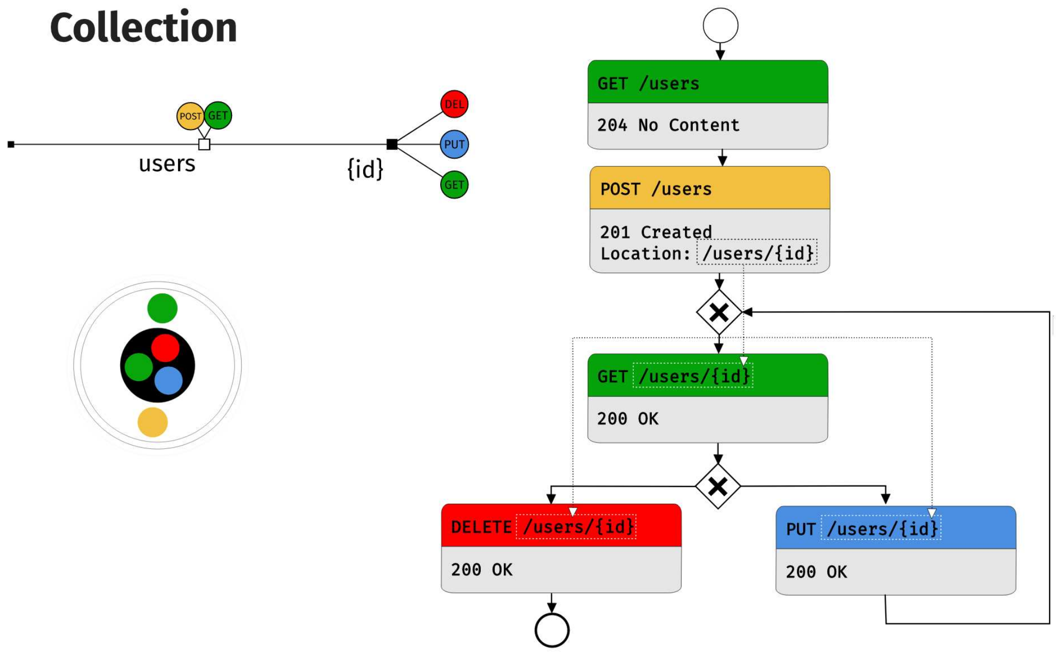
Visualizing API Patterns

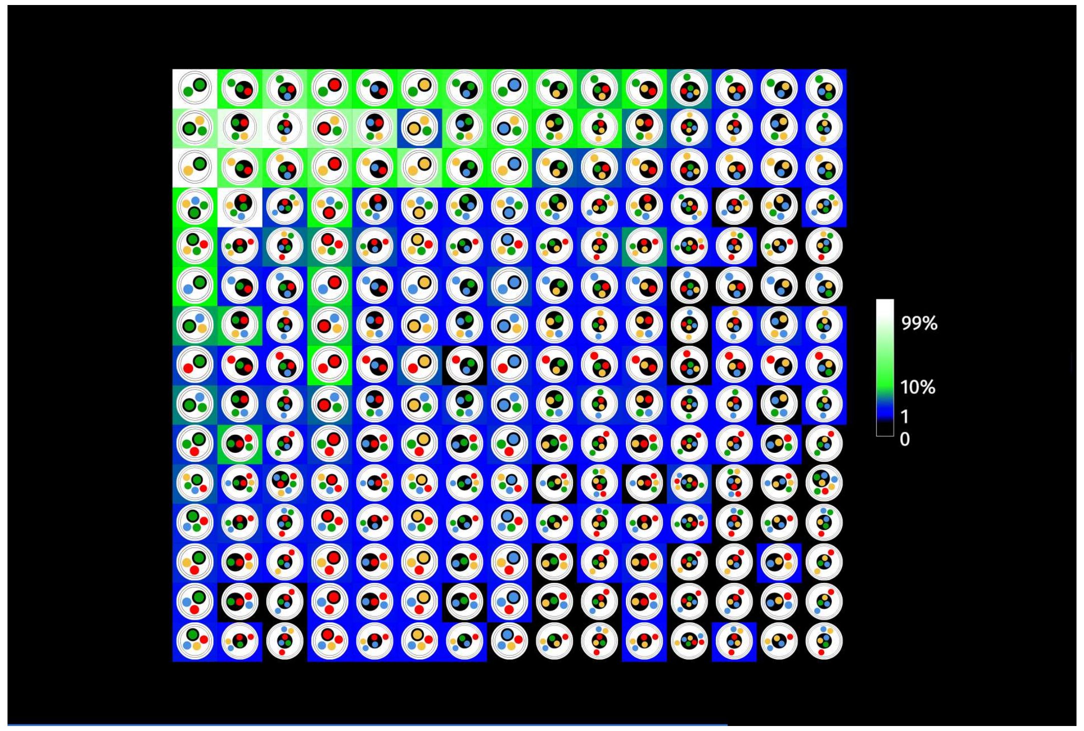
Cesare Pautasso





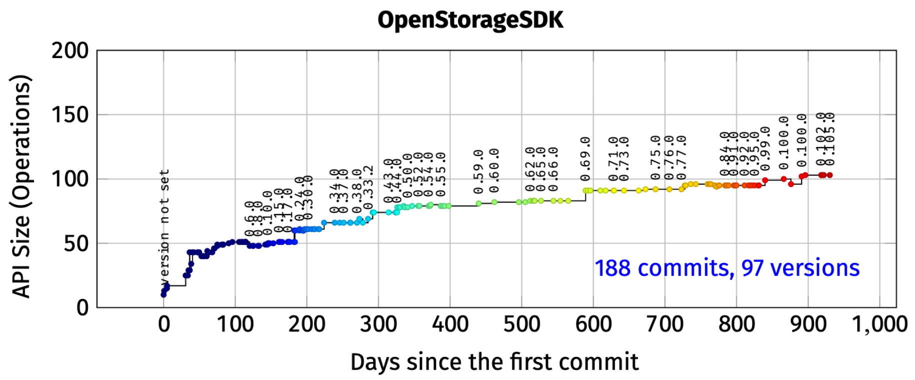
Collection





Version Identifier

Metadata



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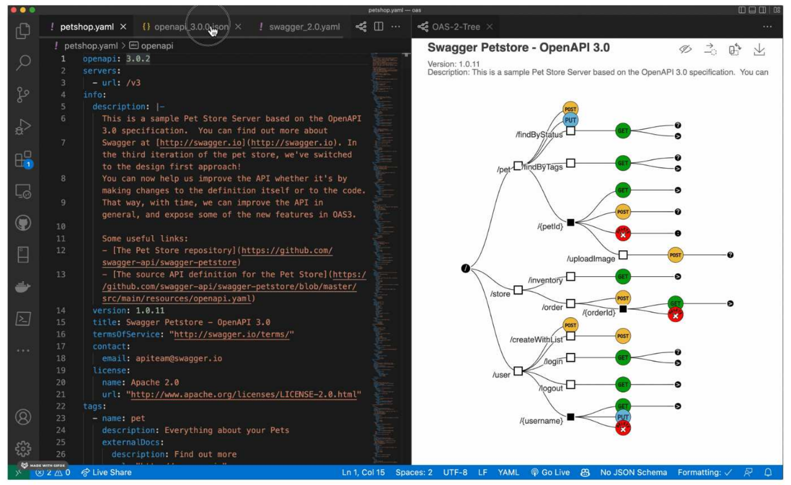

https://marketplace.visualstudio.com/items?itemName=oas2tree.oas2tree

Hamburg, 12.5.23

http://www.pautasso.org/

@pautasso@scholar.social

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- Mike Ralphson, **What We Learned from 200,000 OpenAPI Files**, Postman Blog, 23.8.2021
- Olaf Zimmermann, Mirko Stocker, Uwe Zdun, Daniel Lübke, Cesare Pautasso, **Introduction to Microservice API Patterns (MAP)**, Joint Post-proceedings of the First and Second International Conference on Microservices (Microservices 2017/2019)