CISCO
SECURE

CISCO The bridge to possible

REST API vs GraphQL

HBONE Workshop

Ács György
Technical Solution Architect
2022. május 27.

Agenda

1. REST API – emlékeztető, összefoglaló
2. Mire is jó ez?
3. GraphQL API – talán valami új :)

REST API

REST API

- API framework built on HTTP
- REpresentational State Transfer (REST)
- Uses HTTP methods: GET, POST, PUT, DELETE
- One URL endpoint per resource
- Can use HTTP error codes: e.g. 200, 201, 400, 403, 404, 500
- Independence of client and server
- Cacheable

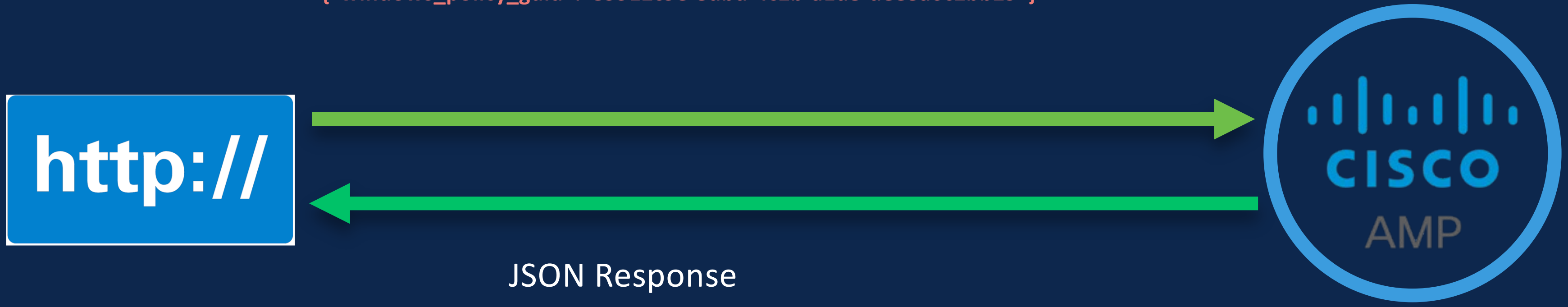
How it works ?

REST Restful Request to API

```
PATCH /v1/groups/b077d6bc-bbdf-42f7-8838-a06053fbd98a
```

Contains JSON Payload

```
{"windows_policy_guid":"89912c9e-8dbd-4c2b-a1d8-dee8a0c2bb29"}
```



JSON Response

```
{
  "version": "v1.0.0",
  "metadata": {
    "links": {
      "self": "https://api.amp.cisco.com/v1/version"
    }
  },
  "data": {}
}
```

What is JSON?

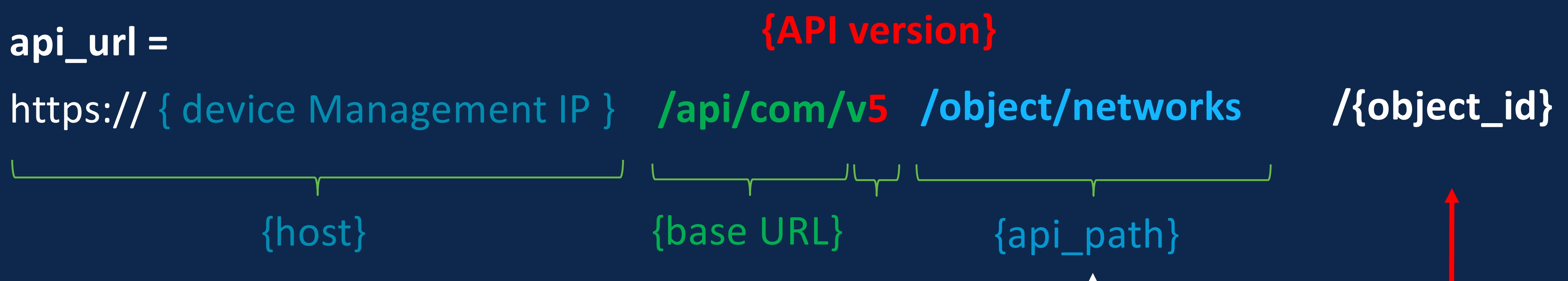
- **Standardized format for passing data as text.**
- JavaScript Object Notation
- **JSON is just text!**
- **Store data in a easy to access and organized object**

```
{
  "ietf-interfaces:interface": {
    "name": "GigabitEthernet2",
    "description": "Wide Area Network",
    "enabled": true,
    "ietf-ip:ipv4": {
      "address": [
        {
          "ip":"172.16.0.2",
          "netmask":"255.255.255.0"
        }
      ]
    }
  }
}
```

Dealing with API is dealing with

- The API Endpoint
- REST Verbs
- Variables to pass
- Authentication
- Error Code Management

The API Endpoint

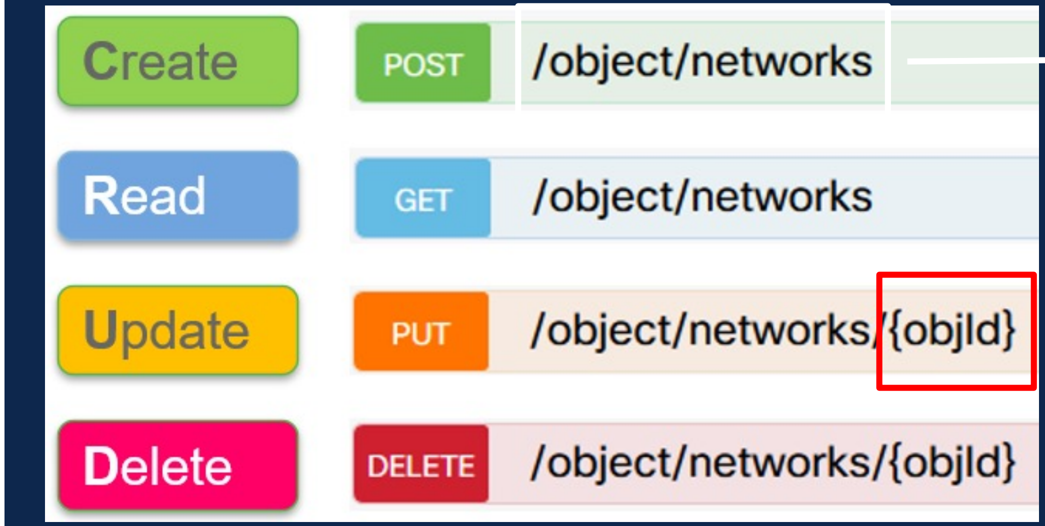


{API version}

api_url =

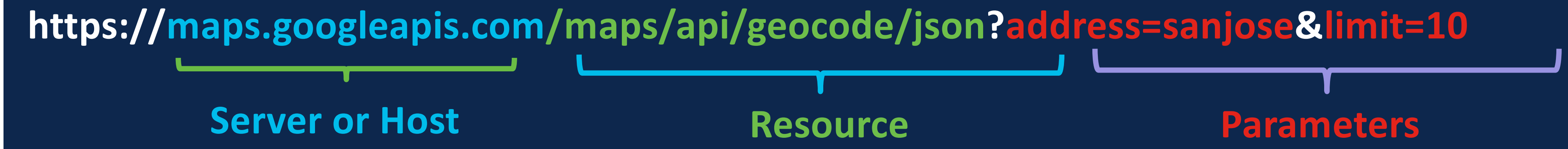
https:// { device Management IP } /api/com/v5 /object/networks /{object_id}

{host} {base URL} {api_path}



Create	POST	/object/networks
Read	GET	/object/networks
Update	PUT	/object/networks/{objId}
Delete	DELETE	/object/networks/{objId}

Query Parameters (ex : GET Method)



https://maps.googleapis.com/maps/api/geocode/json?address=sanjose&limit=10

Server or Host

Resource

Parameters

- **Parameters**
  - Details to scope, filter, or clarify a request. Often optional.

JSON Syntax vs. Python Syntax

```
{
  "ietf-interfaces:interface": {
    "name": "GigabitEthernet2",
    "description": "Wide Area Network",
    "enabled": true,
    "ietf-ip:ipv4": {
      "address": [
        {
          "ip":"172.16.0.2",
          "netmask":"255.255.255.0"
        }
      ]
    }
  }
}
```

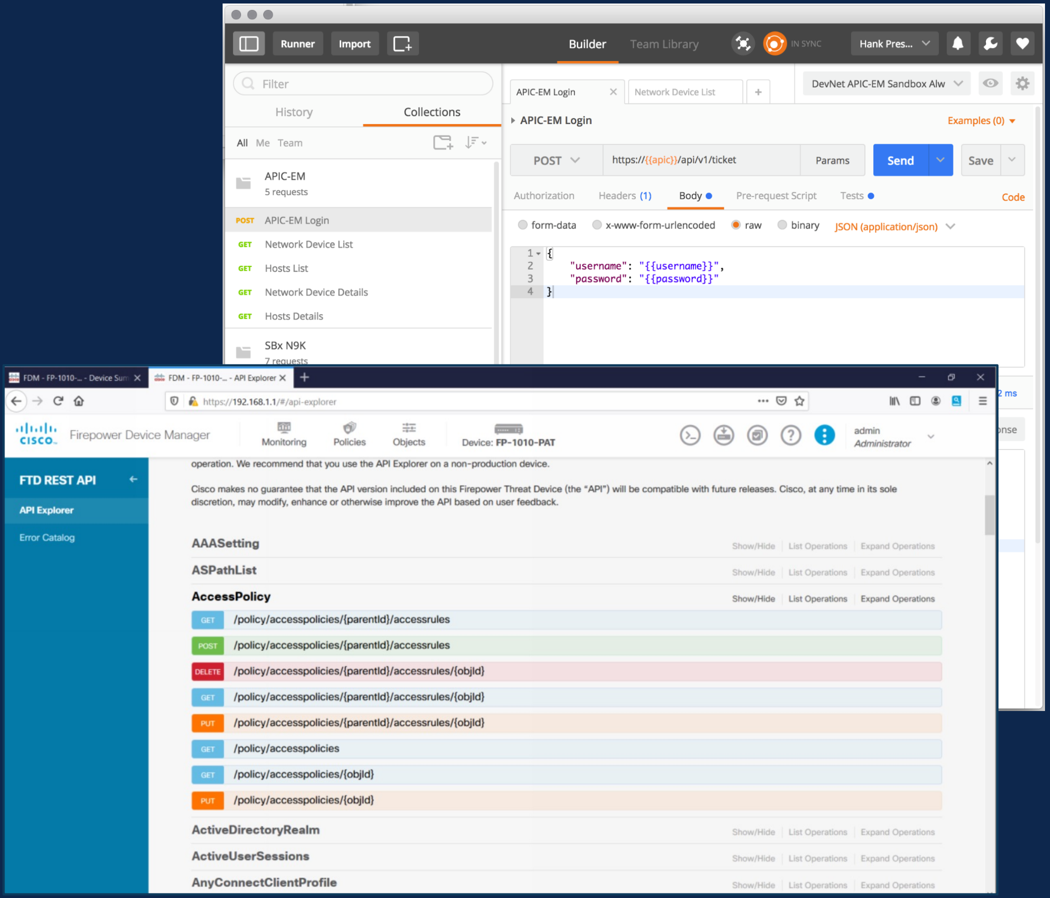
JSON

```
{
  'ietf-interfaces:interface': {
    'name’: 'GigabitEthernet2’,
    'description’: 'Wide Area Network’,
    'enabled’: True,
    'ietf-ip:ipv4': {
      'address': [
        {
          'ip':'172.16.0.2’,
          'netmask':'255.255.255.0’,
        },
      ],
    },
  },
}
```

Python

Many Options for Working with REST APIs

- curl
  - Linux command line application
- Postman
  - API testing application and framework
- Requests
  - Python library for scripting
- OpenAPI/Swagger
  - Dynamic API Documentation



APIC-EM Login

POST https://{{apic}}/api/v1/ticket

```
{
    "username": "{{username}}",
    "password": "{{password}}"
}
```

https://192.168.1.1/#/api-explorer

Device: FP-1010-PAT

operation. We recommend that you use the API Explorer on a non-production device.

Cisco makes no guarantee that the API version included on this Firepower Threat Device (the "API") will be compatible with future releases. Cisco, at any time in its sole discretion, may modify, enhance or otherwise improve the API based on user feedback.

AAASetting — Show/Hide | List Operations | Expand Operations

ASPathList — Show/Hide | List Operations | Expand Operations

AccessPolicy — Show/Hide | List Operations | Expand Operations

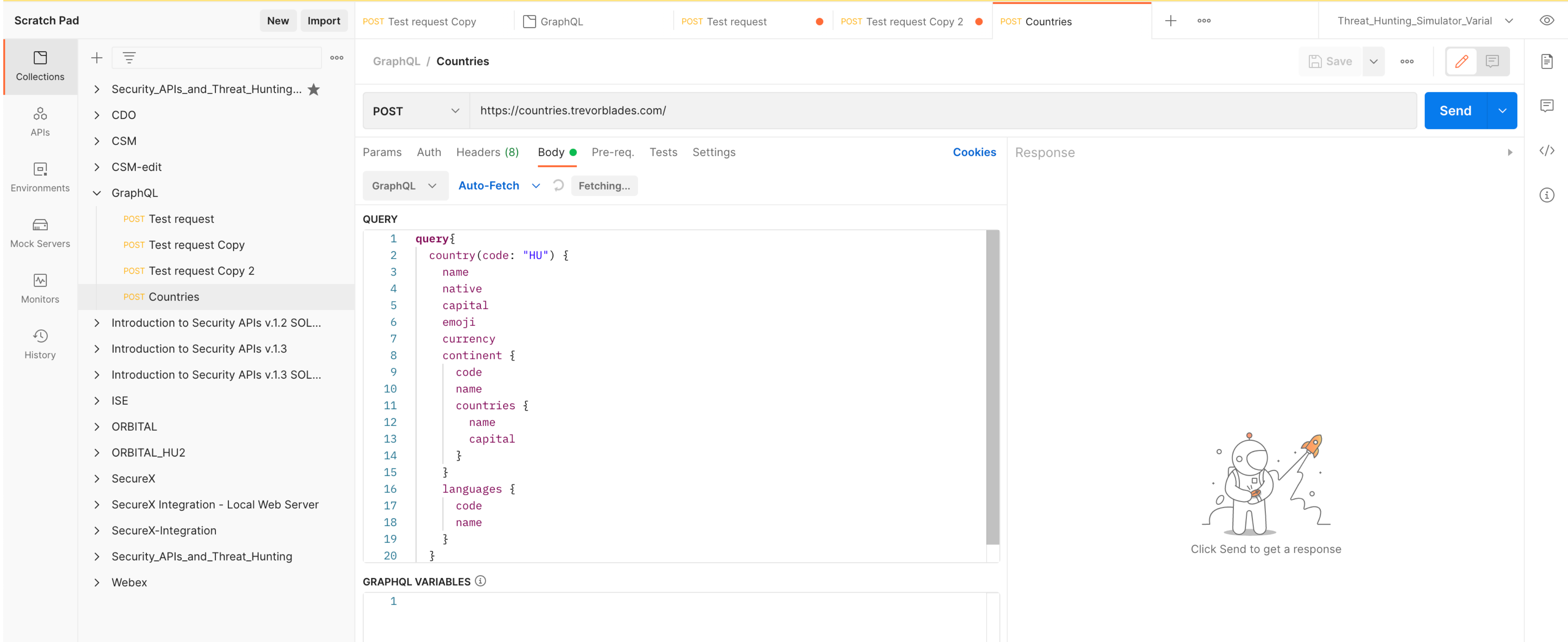
GET /policy/accesspolicies/{parentId}/accessrules
POST /policy/accesspolicies/{parentId}/accessrules
DELETE /policy/accesspolicies/{parentId}/accessrules/{objId}
GET /policy/accesspolicies/{parentId}/accessrules/{objId}
PUT /policy/accesspolicies/{parentId}/accessrules/{objId}
GET /policy/accesspolicies
GET /policy/accesspolicies/{objId}
PUT /policy/accesspolicies/{objId}

ActiveDirectoryRealm — Show/Hide | List Operations | Expand Operations

ActiveUserSessions — Show/Hide | List Operations | Expand Operations

AnyConnectClientProfile — Show/Hide | List Operations | Expand Operations

Postman



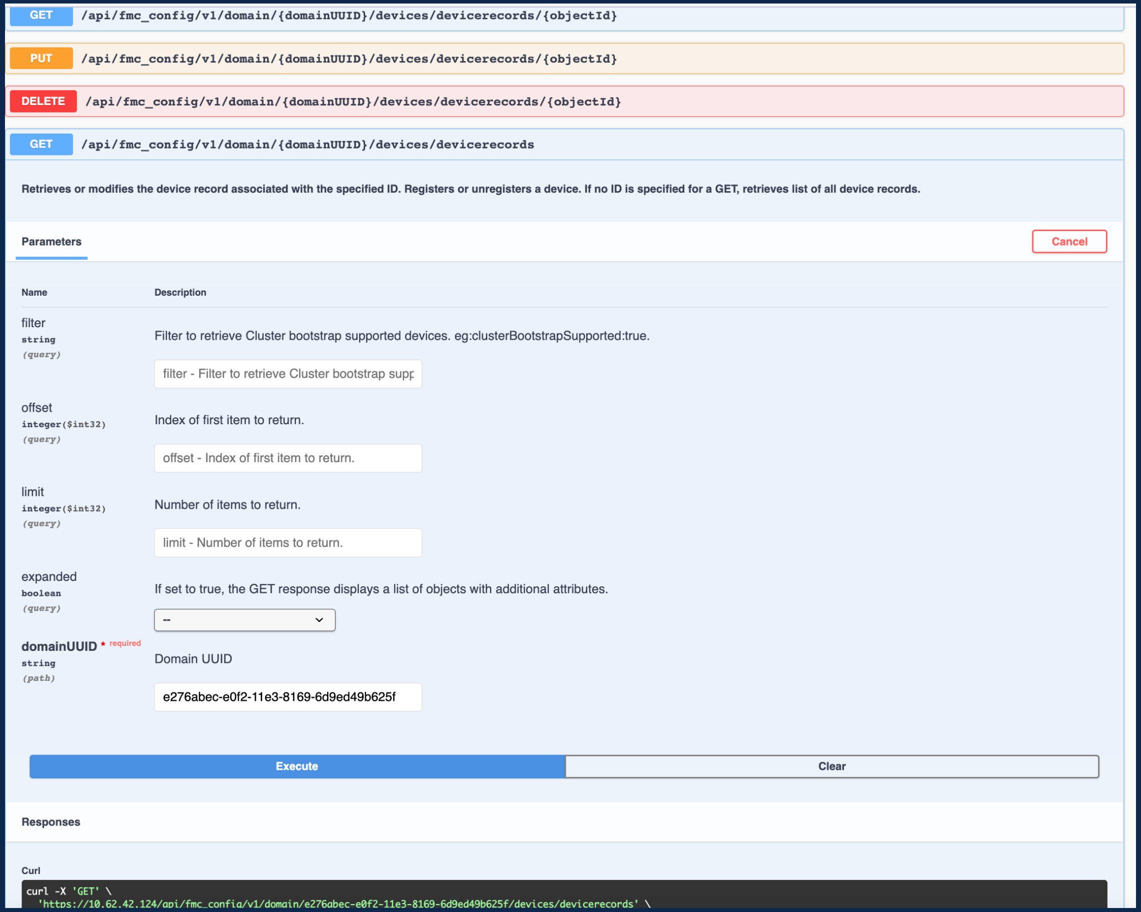
POST https://countries.trevorblades.com/

QUERY

```
query{
  country(code: "HU") {
    name
    native
    capital
    emoji
    currency
    continent {
      code
      name
      countries {
        name
        capital
      }
    }
    languages {
      code
      name
    }
  }
```

GRAPHQL VARIABLES

In the API Documentation (API explorer)



GET /api/fmc_config/v1/domain/{domainUUID}/devices/devicerecords/{objectId}

PUT /api/fmc_config/v1/domain/{domainUUID}/devices/devicerecords/{objectId}

DELETE /api/fmc_config/v1/domain/{domainUUID}/devices/devicerecords/{objectId}

GET /api/fmc_config/v1/domain/{domainUUID}/devices/devicerecords

Retrieves or modifies the device record associated with the specified ID. Registers or unregisters a device. If no ID is specified for a GET, retrieves list of all device records.

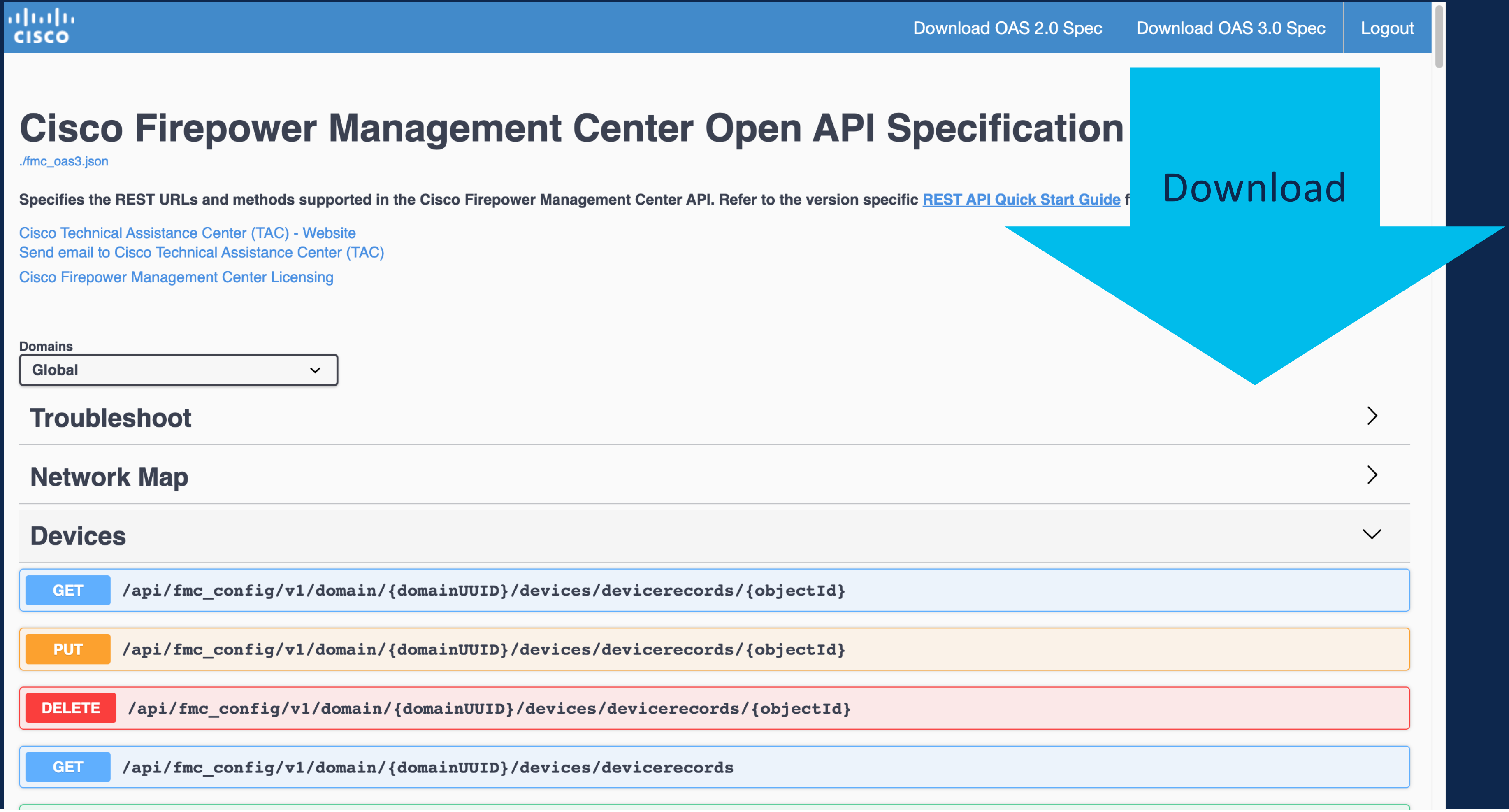
Name	Description
filter string *(query)*	Filter to retrieve Cluster bootstrap supported devices. eg:clusterBootstrapSupported:true. filter - Filter to retrieve Cluster bootstrap supp
offset integer($int32) *(query)*	Index of first item to return. offset - Index of first item to return.
limit integer($int32) *(query)*	Number of items to return. limit - Number of items to return.
expanded boolean *(query)*	If set to true, the GET response displays a list of objects with additional attributes. --
domainUUID * required string *(path)*	Domain UUID e276abec-e0f2-11e3-8169-6d9ed49b625f

Responses

Curl

```
curl -X 'GET' \
  'https://10.62.42.124/api/fmc_config/v1/domain/e276abec-e0f2-11e3-8169-6d9ed49b625f/devices/devicerecords' \
```

Swagger



Cisco Firepower Management Center Open API Specification

./fmc_oas3.json

Specifies the REST URLs and methods supported in the Cisco Firepower Management Center API. Refer to the version specific REST API Quick Start Guide f

Cisco Technical Assistance Center (TAC) - Website
Send email to Cisco Technical Assistance Center (TAC)
Cisco Firepower Management Center Licensing

Domains: Global

Troubleshoot

Network Map

Devices

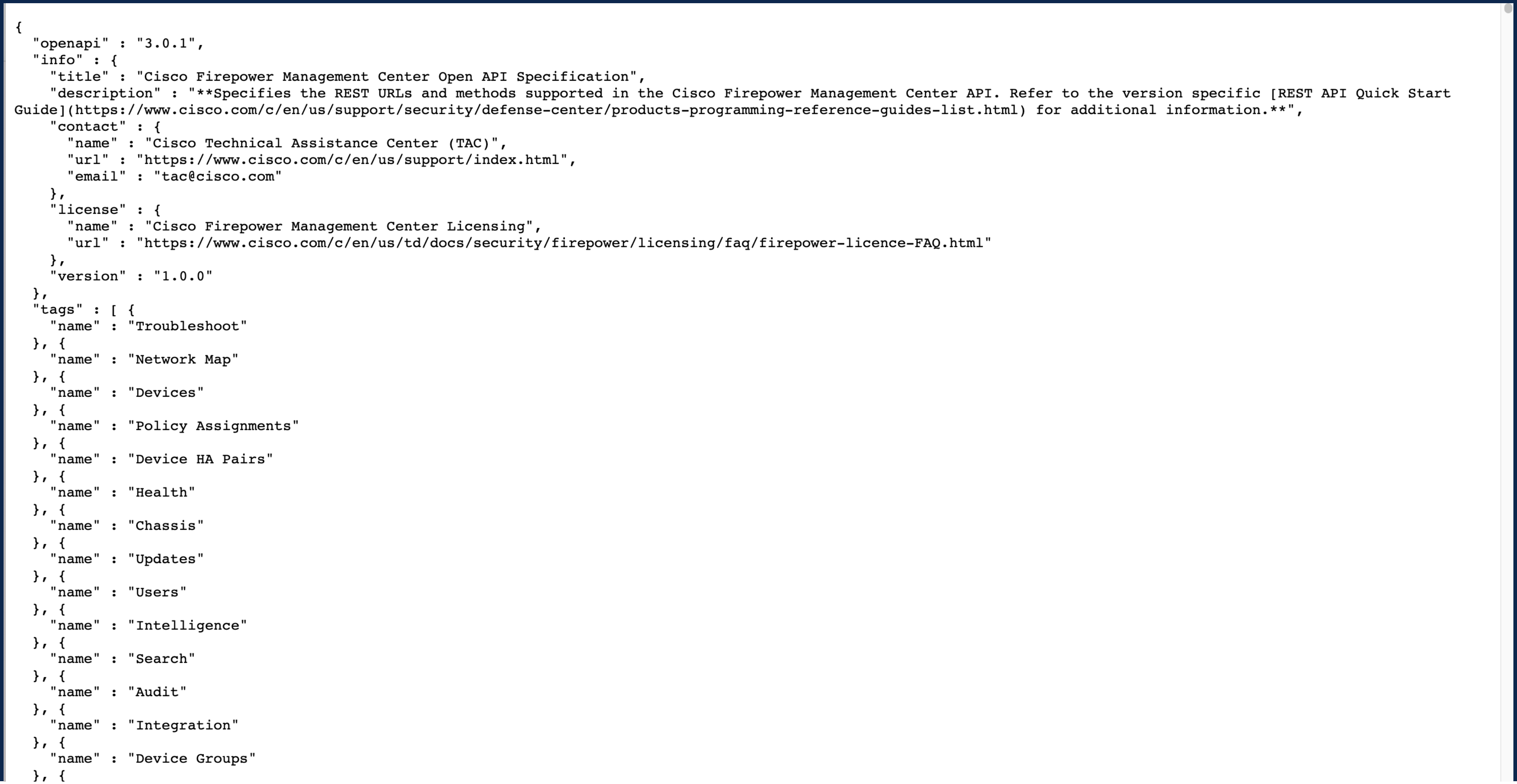
GET /api/fmc_config/v1/domain/{domainUUID}/devices/devicerecords/{objectId}

PUT /api/fmc_config/v1/domain/{domainUUID}/devices/devicerecords/{objectId}

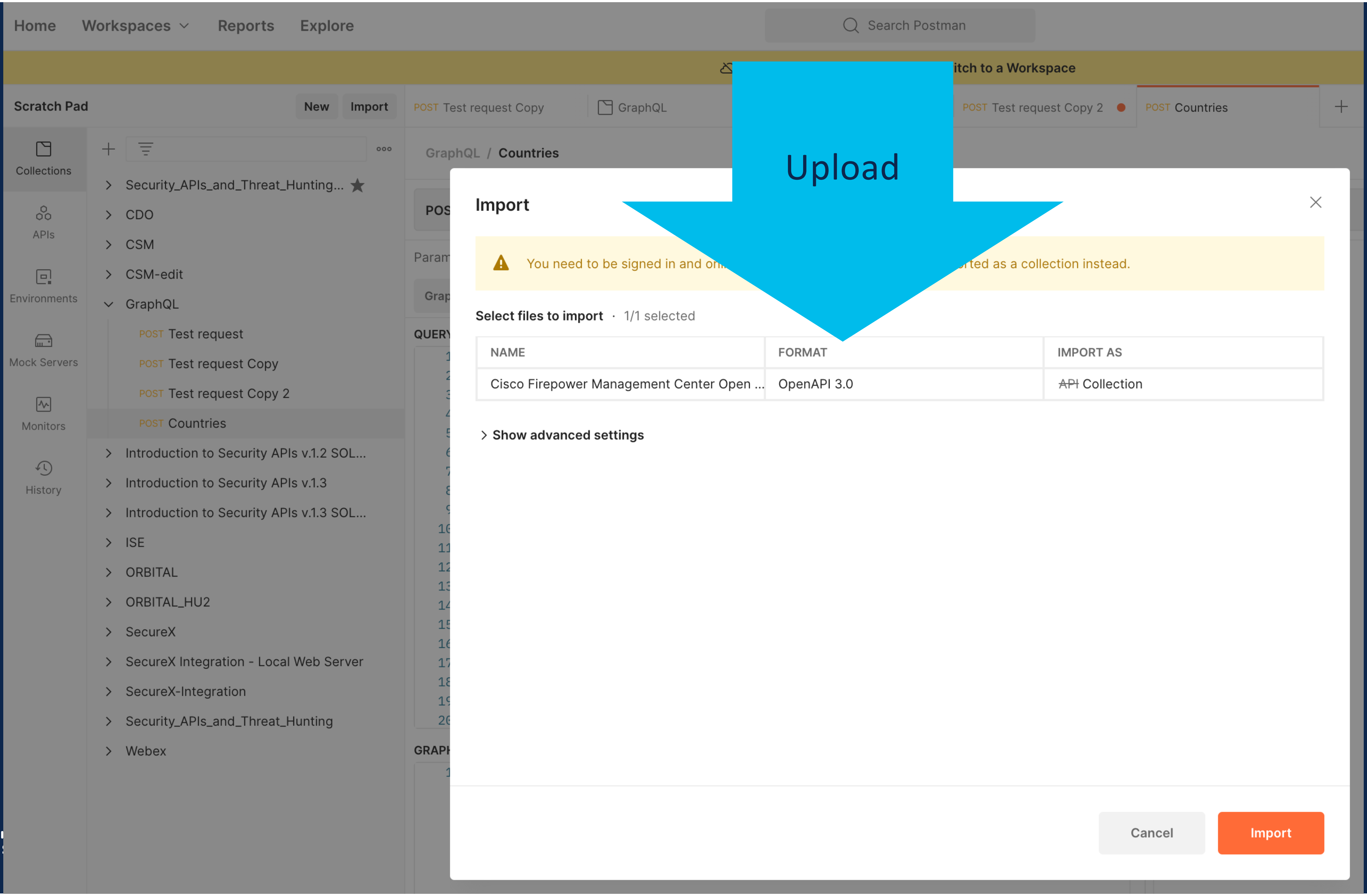
DELETE /api/fmc_config/v1/domain/{domainUUID}/devices/devicerecords/{objectId}

GET /api/fmc_config/v1/domain/{domainUUID}/devices/devicerecords

API definition in JSON



```
{
  "openapi" : "3.0.1",
  "info" : {
    "title" : "Cisco Firepower Management Center Open API Specification",
    "description" : "**Specifies the REST URLs and methods supported in the Cisco Firepower Management Center API. Refer to the version specific [REST API Quick Start
Guide](https://www.cisco.com/c/en/us/support/security/defense-center/products-programming-reference-guides-list.html) for additional information.**",
    "contact" : {
      "name" : "Cisco Technical Assistance Center (TAC)",
      "url" : "https://www.cisco.com/c/en/us/support/index.html",
      "email" : "tac@cisco.com"
    },
    "license" : {
      "name" : "Cisco Firepower Management Center Licensing",
      "url" : "https://www.cisco.com/c/en/us/td/docs/security/firepower/licensing/faq/firepower-licence-FAQ.html"
    },
    "version" : "1.0.0"
  },
  "tags" : [ {
    "name" : "Troubleshoot"
  }, {
    "name" : "Network Map"
  }, {
    "name" : "Devices"
  }, {
    "name" : "Policy Assignments"
  }, {
    "name" : "Device HA Pairs"
  }, {
    "name" : "Health"
  }, {
    "name" : "Chassis"
  }, {
    "name" : "Updates"
  }, {
    "name" : "Users"
  }, {
    "name" : "Intelligence"
  }, {
    "name" : "Search"
  }, {
    "name" : "Audit"
  }, {
    "name" : "Integration"
  }, {
    "name" : "Device Groups"
  }, {
```



Upload

Import

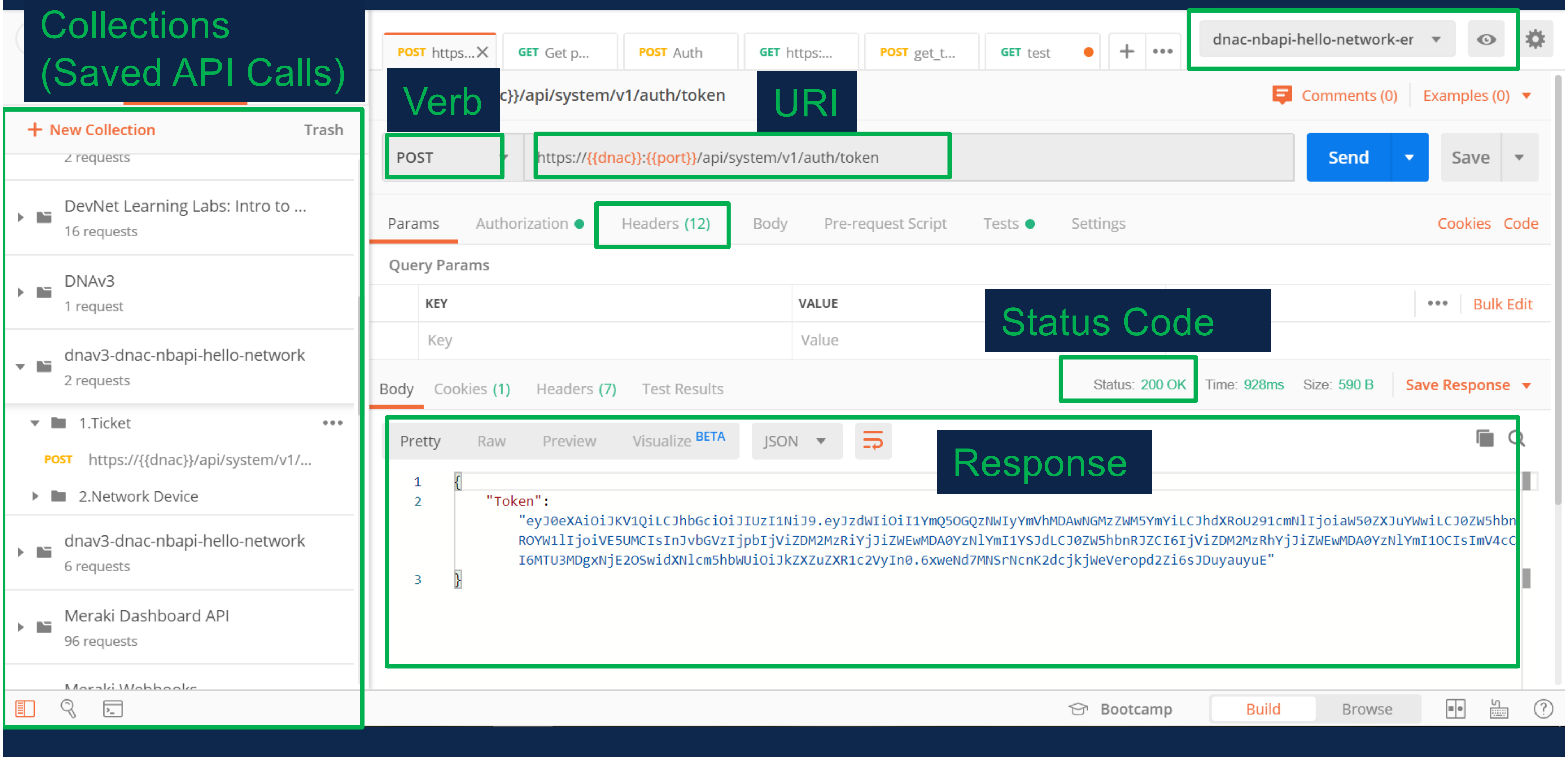
⚠ You need to be signed in and on... ...rted as a collection instead.

Select files to import · 1/1 selected

NAME	FORMAT	IMPORT AS
Cisco Firepower Management Center Open ...	OpenAPI 3.0	~~API~~ Collection

› Show advanced settings

Postman Overview

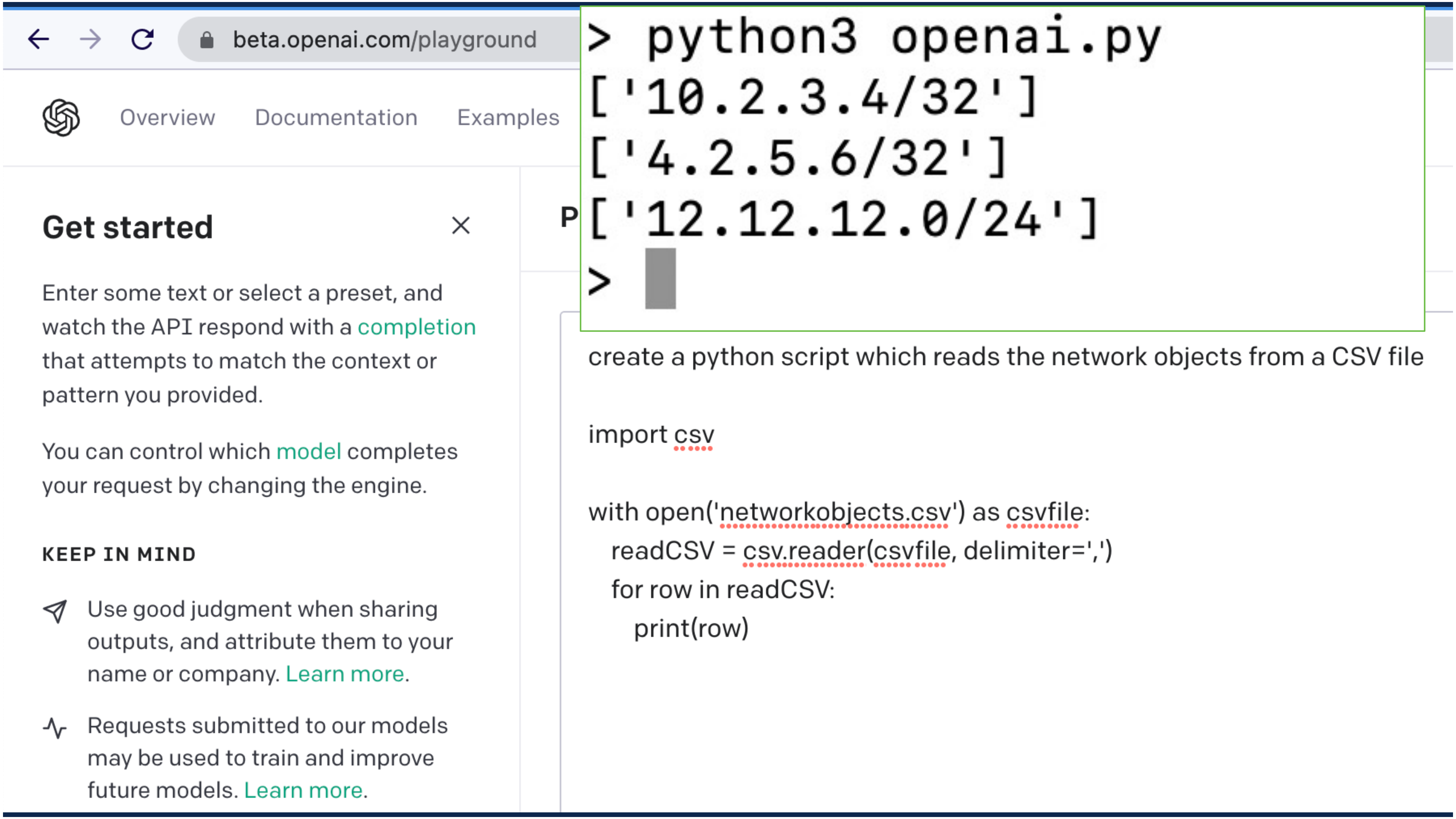


POST https://{{dnac}}:{{port}}/api/system/v1/auth/token

Status: 200 OK Time: 928ms Size: 590 B

```
{
    "Token":
        "eyJ0eXAiOiJKV1QiLCJhbGciOiJIUzI1NiJ9.eyJzdWIiOiI1YmQ5OGQzNWIyYmVhMDAwNGMzZWM5YmYiLCJhdXRoU291cmNlIjoiaW50ZXJuYWwiLCJ0ZW5hbn
        ROYW1lIjoiVE5UMCIsInJvbGVzIjpbIjViZDM2MzRiYjJiZWEwMDA0YzNlYmI1YSJdLCJ0ZW5hbnRJZCI6IjViZDM2MzRhYjJiZWEwMDA0YzNlYmI1OCIsImV4cC
        I6MTU3MDgxNjE2OSwidXNlcm5hbWUiOiJkZXZuZXR1c2VyIn0.6xweNd7MNSrNcnK2dcjkjWeVeropd2Zi6sJDuyauyuE"
}
```

```
import requests

url = "https://10.1.1.1/api/fmc_config/v1/domain/e276abec-
e0f2-11e3-8169-6c9ed49c62ff/devices/devicerecords"

payload={}
headers = {
'Accept': 'application/json',
'X-auth-access-token': 'c9acab7a-a57a-4b67-acbc-b7f07539fcc3'
}

response = requests.request("GET", url, headers=headers,
data=payload)

print(response.text)
```



```
> python3 openai.py
['10.2.3.4/32']
['4.2.5.6/32']
['12.12.12.0/24']
> 
```

Get started

Enter some text or select a preset, and watch the API respond with a completion that attempts to match the context or pattern you provided.

You can control which model completes your request by changing the engine.

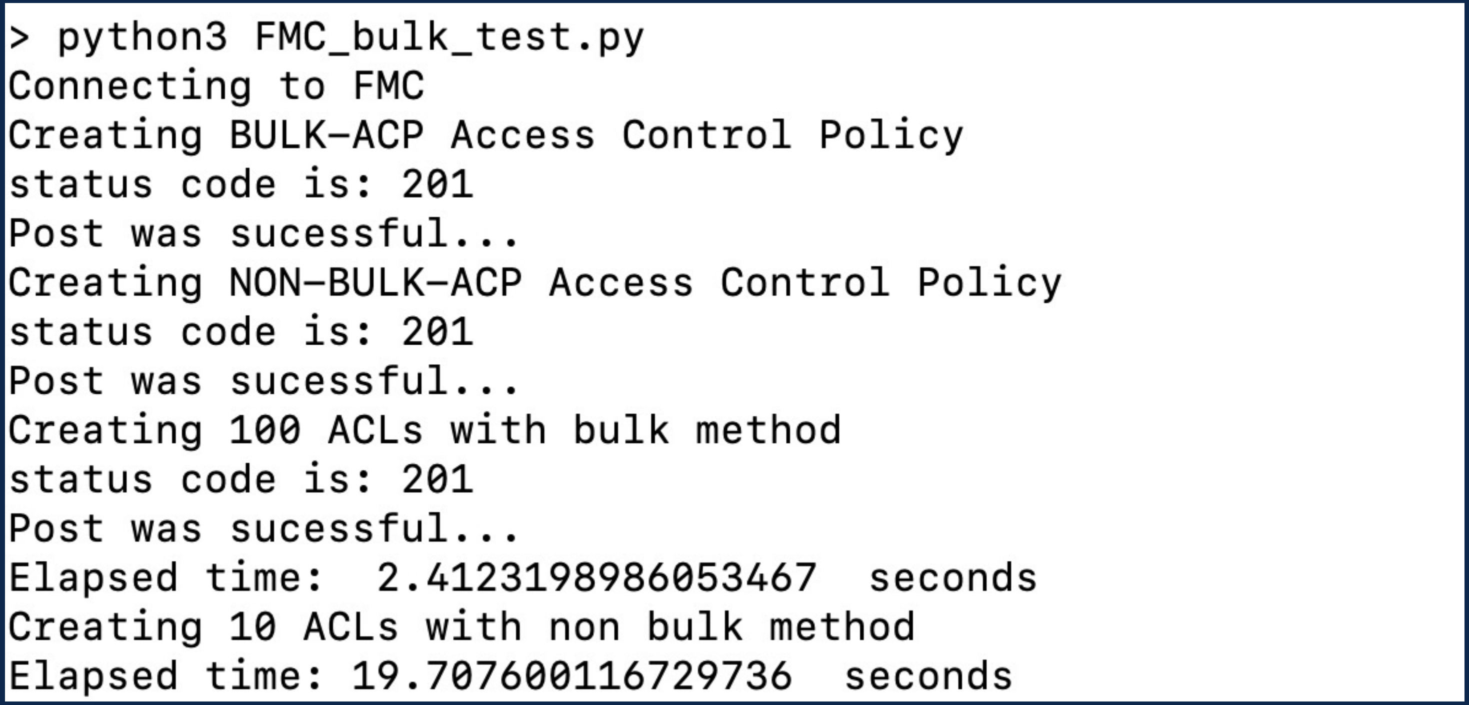
KEEP IN MIND

- Use good judgment when sharing outputs, and attribute them to your name or company. Learn more.
- Requests submitted to our models may be used to train and improve future models. Learn more.

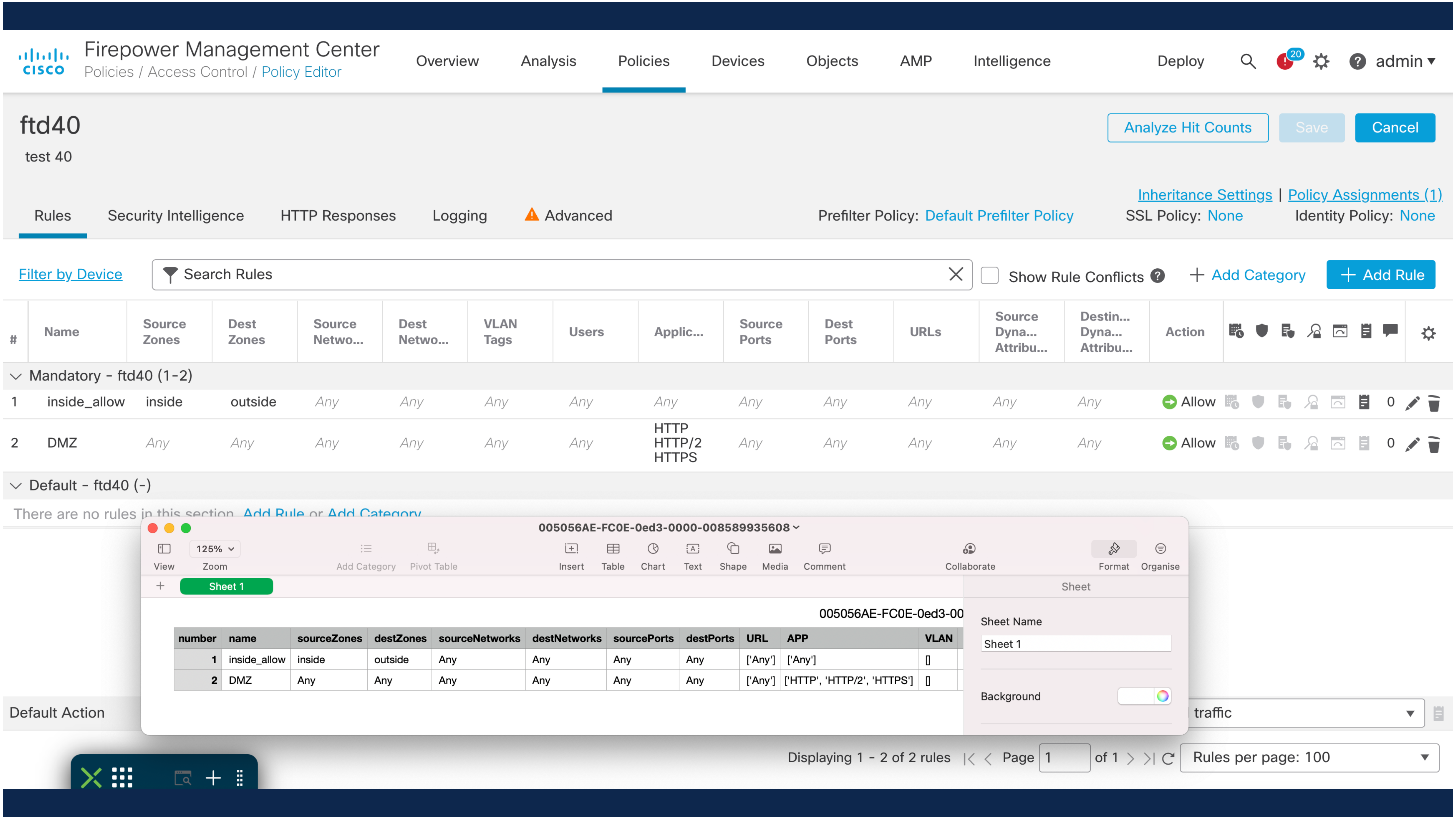
```
create a python script which reads the network objects from a CSV file

import csv

with open('networkobjects.csv') as csvfile:
  readCSV = csv.reader(csvfile, delimiter=',')
  for row in readCSV:
    print(row)
```

To be or not to be -> Bulk OR NOT Bulk? [Ömlesztett]

- https://github.com/Gyuri1/FMC_bulk_demo



```
> python3 FMC_bulk_test.py
Connecting to FMC
Creating BULK-ACP Access Control Policy
status code is: 201
Post was sucessful...
Creating NON-BULK-ACP Access Control Policy
status code is: 201
Post was sucessful...
Creating 100 ACLs with bulk method
status code is: 201
Post was sucessful...
Elapsed time:  2.4123198986053467  seconds
Creating 10 ACLs with non bulk method
Elapsed time: 19.707600116729736  seconds
```



Firepower Management Center
Policies / Access Control / Policy Editor

ftd40

test 40

Prefilter Policy: Default Prefilter Policy
SSL Policy: None
Identity Policy: None

#	Name	Source Zones	Dest Zones	Source Netwo...	Dest Netwo...	VLAN Tags	Users	Applic...	Source Ports	Dest Ports	URLs	Source Dyna... Attribu...	Destin... Dyna... Attribu...	Action	
Mandatory - ftd40 (1-2)															
1	inside_allow	inside	outside	Any	Any	Any	Any	Any	Any	Any	Any	Any	Any	Allow	0
2	DMZ	Any	Any	Any	Any	Any	Any	HTTP HTTP/2 HTTPS	Any	Any	Any	Any	Any	Allow	0
Default - ftd40 (-)															

There are no rules in this section. Add Rule or Add Category

Default Action

traffic

Displaying 1 - 2 of 2 rules

Page 1 of 1

Rules per page: 100

005056AE-FC0E-0ed3-0000-008589935608

005056AE-FC0E-0ed3-00

number	name	sourceZones	destZones	sourceNetworks	destNetworks	sourcePorts	destPorts	URL	APP	VLAN
1	inside_allow	inside	outside	Any	Any	Any	Any	['Any']	['Any']	[]
2	DMZ	Any	Any	Any	Any	Any	Any	['Any']	['HTTP', 'HTTP/2', 'HTTPS']	[]

Sheet Name

Sheet 1

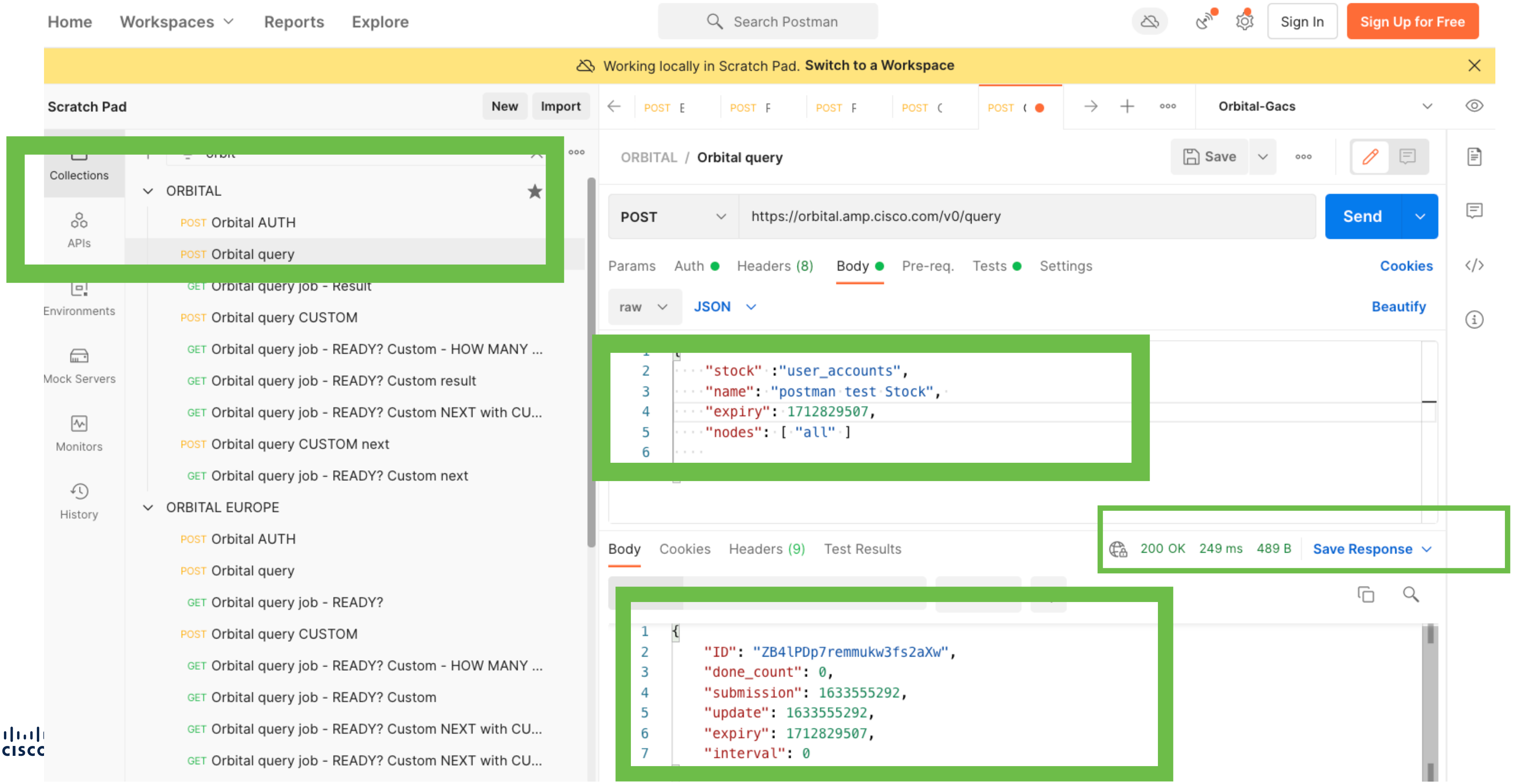
Background

Mire is jó ez?

REST API vs GraphQL in Cisco Security Products

- REST API: ALL,
  - Identity Services Engine, Secure Endpoint
  - Secure Firewall, FMC, CDO
  - Secure Network Analytics (network anomaly detector)
  - Secure Malware Analytics (~ sandbox)
  - Secure Email, Web, Duo, SecureX
  - …
- GraphQL:
  - CDO

Orbital, https://orbital.amp.cisco.com/help/api/



ORBITAL
- POST Orbital AUTH
- POST Orbital query
- GET Orbital query job - Result
- POST Orbital query CUSTOM
- GET Orbital query job - READY? Custom - HOW MANY ...
- GET Orbital query job - READY? Custom result
- GET Orbital query job - READY? Custom NEXT with CU...
- POST Orbital query CUSTOM next
- GET Orbital query job - READY? Custom next

ORBITAL EUROPE
- POST Orbital AUTH
- POST Orbital query
- GET Orbital query job - READY?
- POST Orbital query CUSTOM
- GET Orbital query job - READY? Custom - HOW MANY ...
- GET Orbital query job - READY? Custom
- GET Orbital query job - READY? Custom NEXT with CU...
- GET Orbital query job - READY? Custom NEXT with CU...

ORBITAL / Orbital query

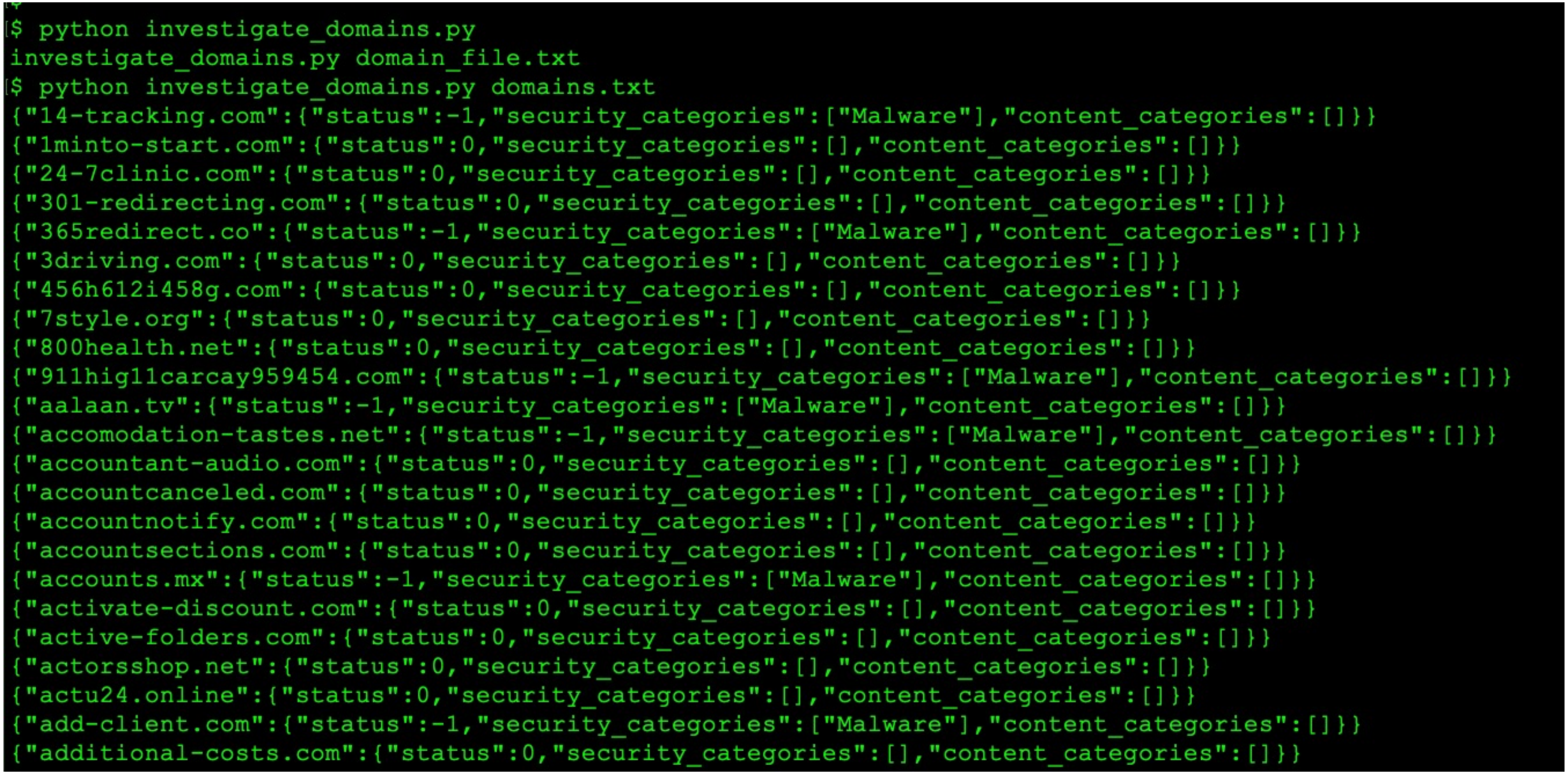
POST https://orbital.amp.cisco.com/v0/query

```
    "stock" :"user_accounts",
    "name": "postman test Stock",
    "expiry": 1712829507,
    "nodes": [ "all" ]
```

200 OK 249 ms 489 B

```
{
    "ID": "ZB4lPDp7remmukw3fs2aXw",
    "done_count": 0,
    "submission": 1633555292,
    "update": 1633555292,
    "expiry": 1712829507,
    "interval": 0
```

Do You remember these domains? ☺

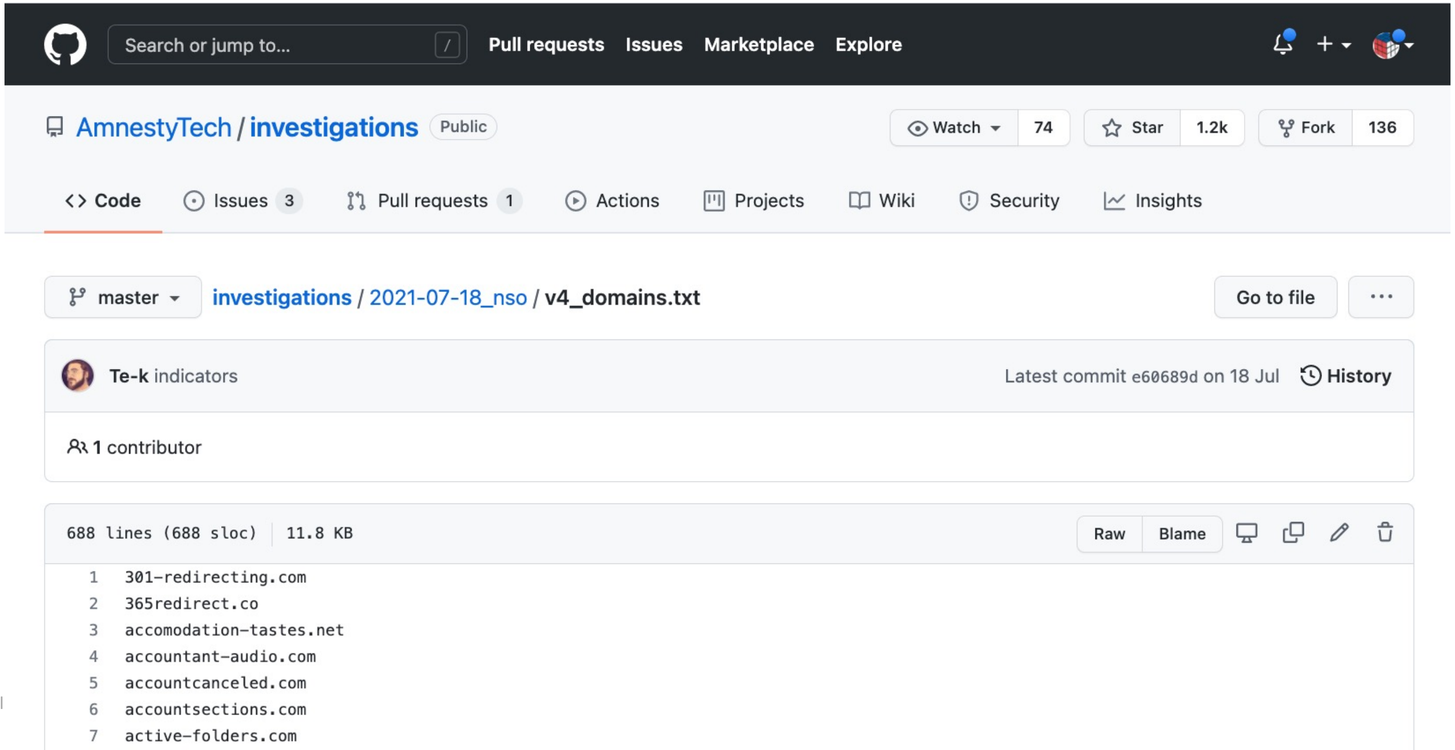


```
[$ python investigate_domains.py
investigate_domains.py domain_file.txt
[$ python investigate_domains.py domains.txt
{"14-tracking.com":{"status":-1,"security_categories":["Malware"],"content_categories":[]}}
{"1minto-start.com":{"status":0,"security_categories":[],"content_categories":[]}}
{"24-7clinic.com":{"status":0,"security_categories":[],"content_categories":[]}}
{"301-redirecting.com":{"status":0,"security_categories":[],"content_categories":[]}}
{"365redirect.co":{"status":-1,"security_categories":["Malware"],"content_categories":[]}}
{"3driving.com":{"status":0,"security_categories":[],"content_categories":[]}}
{"456h612i458g.com":{"status":0,"security_categories":[],"content_categories":[]}}
{"7style.org":{"status":0,"security_categories":[],"content_categories":[]}}
{"800health.net":{"status":0,"security_categories":[],"content_categories":[]}}
{"911hig11carcay959454.com":{"status":-1,"security_categories":["Malware"],"content_categories":[]}}
{"aalaan.tv":{"status":-1,"security_categories":["Malware"],"content_categories":[]}}
{"accomodation-tastes.net":{"status":-1,"security_categories":["Malware"],"content_categories":[]}}
{"accountant-audio.com":{"status":0,"security_categories":[],"content_categories":[]}}
{"accountcanceled.com":{"status":0,"security_categories":[],"content_categories":[]}}
{"accountnotify.com":{"status":0,"security_categories":[],"content_categories":[]}}
{"accountsections.com":{"status":0,"security_categories":[],"content_categories":[]}}
{"accounts.mx":{"status":-1,"security_categories":["Malware"],"content_categories":[]}}
{"activate-discount.com":{"status":0,"security_categories":[],"content_categories":[]}}
{"active-folders.com":{"status":0,"security_categories":[],"content_categories":[]}}
{"actorsshop.net":{"status":0,"security_categories":[],"content_categories":[]}}
{"actu24.online":{"status":0,"security_categories":[],"content_categories":[]}}
{"add-client.com":{"status":-1,"security_categories":["Malware"],"content_categories":[]}}
{"additional-costs.com":{"status":0,"security_categories":[],"content_categories":[]}}
```

Pegasus

https://www.amnesty.org/en/documents/doc10/4487/2021/en/

- https://github.com/AmnestyTech/investigations/blob/master/2021-07-18_nso/v4_domains.txt



investigations / 2021-07-18_nso / v4_domains.txt

Te-k indicators — Latest commit e60689d on 18 Jul

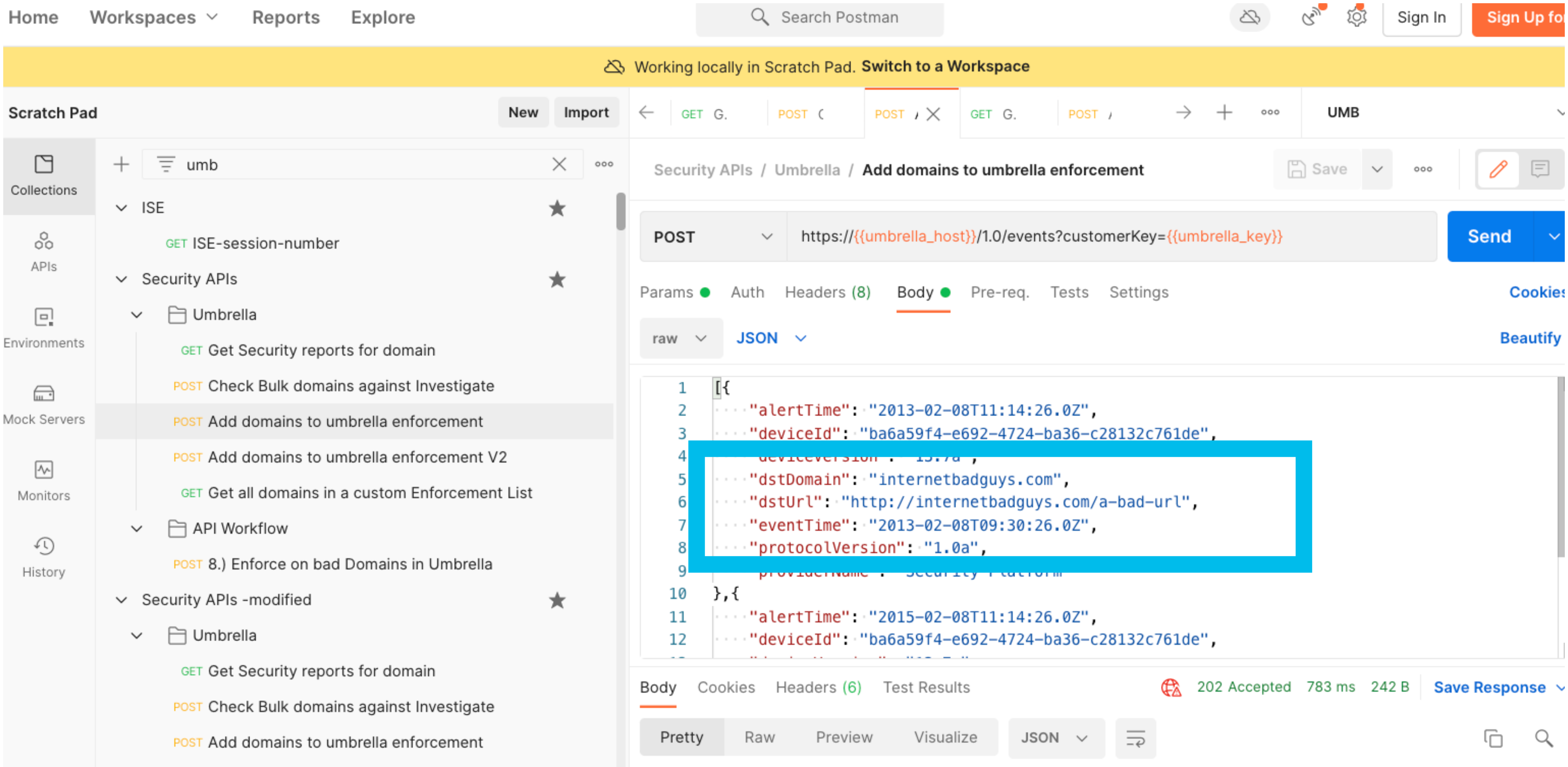
1 contributor

688 lines (688 sloc) | 11.8 KB

```
301-redirecting.com
365redirect.co
accomodation-tastes.net
accountant-audio.com
accountcanceled.com
accountsections.com
active-folders.com
```

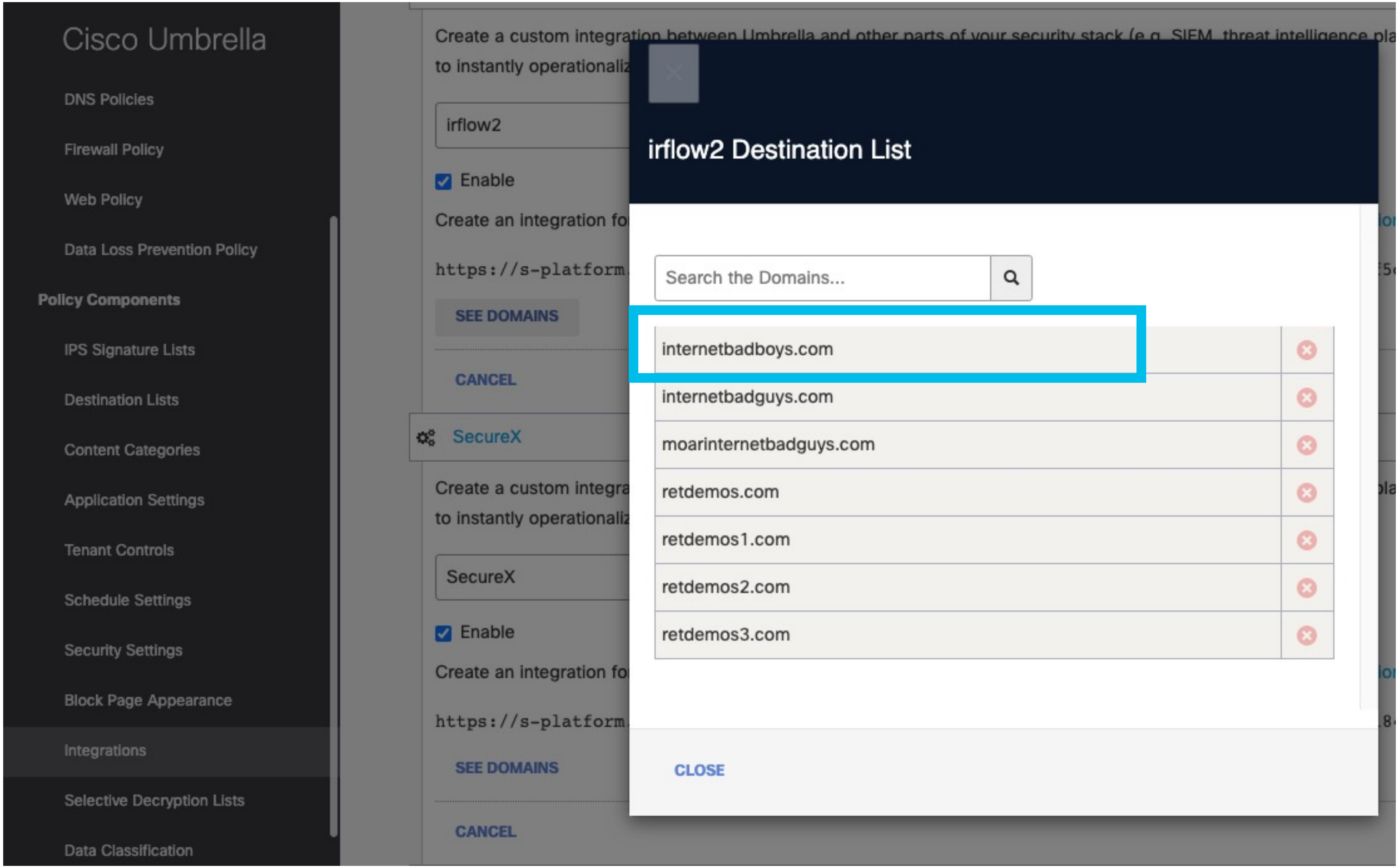
Rename Umbrella Roaming

- https://github.com/Gyuri1/UMBRELLA_ROAMING_DEVICE_RENAME/blob/master/umb-roaming.py


Home
Workspaces
Reports
Explore
Search Postman
Sign In
Sign Up fo
Working locally in Scratch Pad. Switch to a Workspace
Scratch Pad
New
Import
Collections
APIs
Environments
Mock Servers
Monitors
History
umb
ISE
GET ISE-session-number
Security APIs
Umbrella
GET Get Security reports for domain
POST Check Bulk domains against Investigate
POST Add domains to umbrella enforcement
POST Add domains to umbrella enforcement V2
GET Get all domains in a custom Enforcement List
API Workflow
POST 8.) Enforce on bad Domains in Umbrella
Security APIs -modified
Umbrella
GET Get Security reports for domain
POST Check Bulk domains against Investigate
POST Add domains to umbrella enforcement
GET G.
POST (
POST
GET G.
POST
UMB
Security APIs / Umbrella / Add domains to umbrella enforcement
Save
Send
Params
Auth
Headers (8)
Body
Pre-req.
Tests
Settings
Cookies
raw
JSON
Beautify
Body
Cookies
Headers (6)
Test Results
202 Accepted
783 ms
242 B
Save Response
Pretty
Raw
Preview
Visualize
JSON

POST https://{{umbrella_host}}/1.0/events?customerKey={{umbrella_key}}

```
[{
    "alertTime": "2013-02-08T11:14:26.0Z",
    "deviceId": "ba6a59f4-e692-4724-ba36-c28132c761de",
    "deviceVersion": "13.7a",
    "dstDomain": "internetbadguys.com",
    "dstUrl": "http://internetbadguys.com/a-bad-url",
    "eventTime": "2013-02-08T09:30:26.0Z",
    "protocolVersion": "1.0a",
    "providerName": "Security Platform"
},{
    "alertTime": "2015-02-08T11:14:26.0Z",
    "deviceId": "ba6a59f4-e692-4724-ba36-c28132c761de",
```



Create a custom integration between Umbrella and other parts of your security stack (e.g. SIEM, threat intelligence pla

to instantly operationaliz

irflow2

☑ Enable

Create an integration fo

https://s-platform.

Create a custom integra

to instantly operationaliz

SecureX

☑ Enable

Create an integration fo

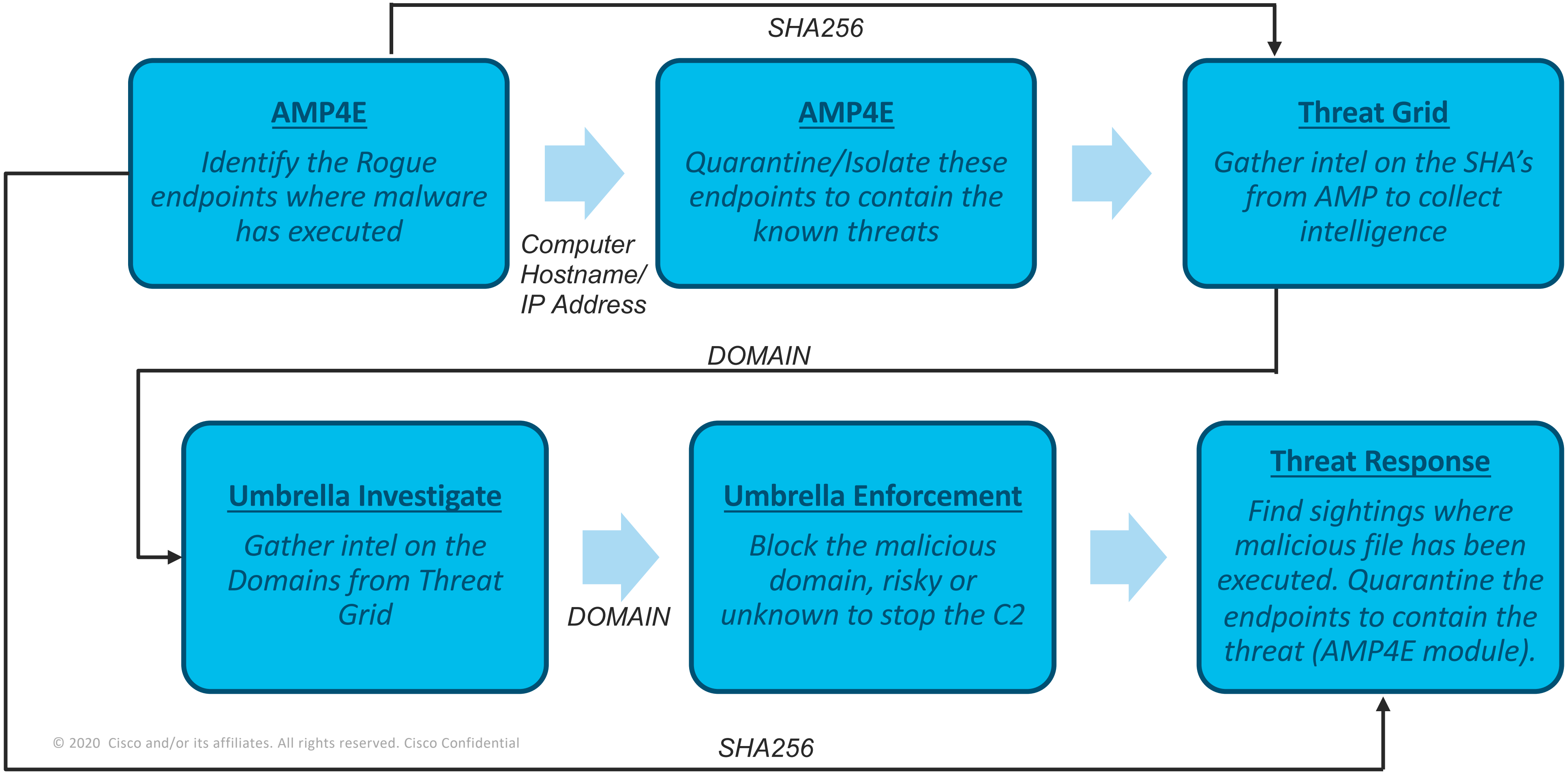
https://s-platform.

irflow2 Destination List

Search the Domains...

- internetbadboys.com
- internetbadguys.com
- moarinternetbadguys.com
- retdemos.com
- retdemos1.com
- retdemos2.com
- retdemos3.com

Threat Investigation & Response Automation Workflow



AMP4E

Identify the Rogue endpoints where malware has executed

AMP4E

Quarantine/Isolate these endpoints to contain the known threats

Threat Grid

Gather intel on the SHA's from AMP to collect intelligence

Umbrella Investigate

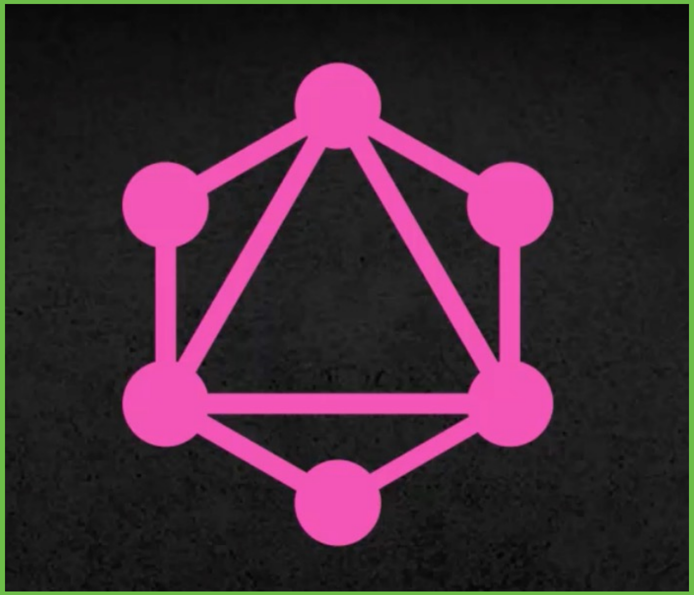
Gather intel on the Domains from Threat Grid

Umbrella Enforcement

Block the malicious domain, risky or unknown to stop the C2

Threat Response

Find sightings where malicious file has been executed. Quarantine the endpoints to contain the threat (AMP4E module).



GraphQL API

GraphQL

- Application layer query language
- Open sourced by Facebook in 2015
- Can be used with any type of database
- Get multiple resources in a single request
- Ability to ask for exactly what you need and nothing more

GraphQL != Database

GraphQL vs Database

The Query:

```
{
  user(id:"100"){
   name
   email
   posts {
       title


    }
  }
}
```

The Data:

```
{
  "user" : {
     "id": "100",
     "name": "Joe",
     "email": "joe@gmail.com" ,
     "posts": [
         {"title": "hi Joe!"  },
         {"title": "hi John!" }
     ]
  }
}
```

GraphQL Types

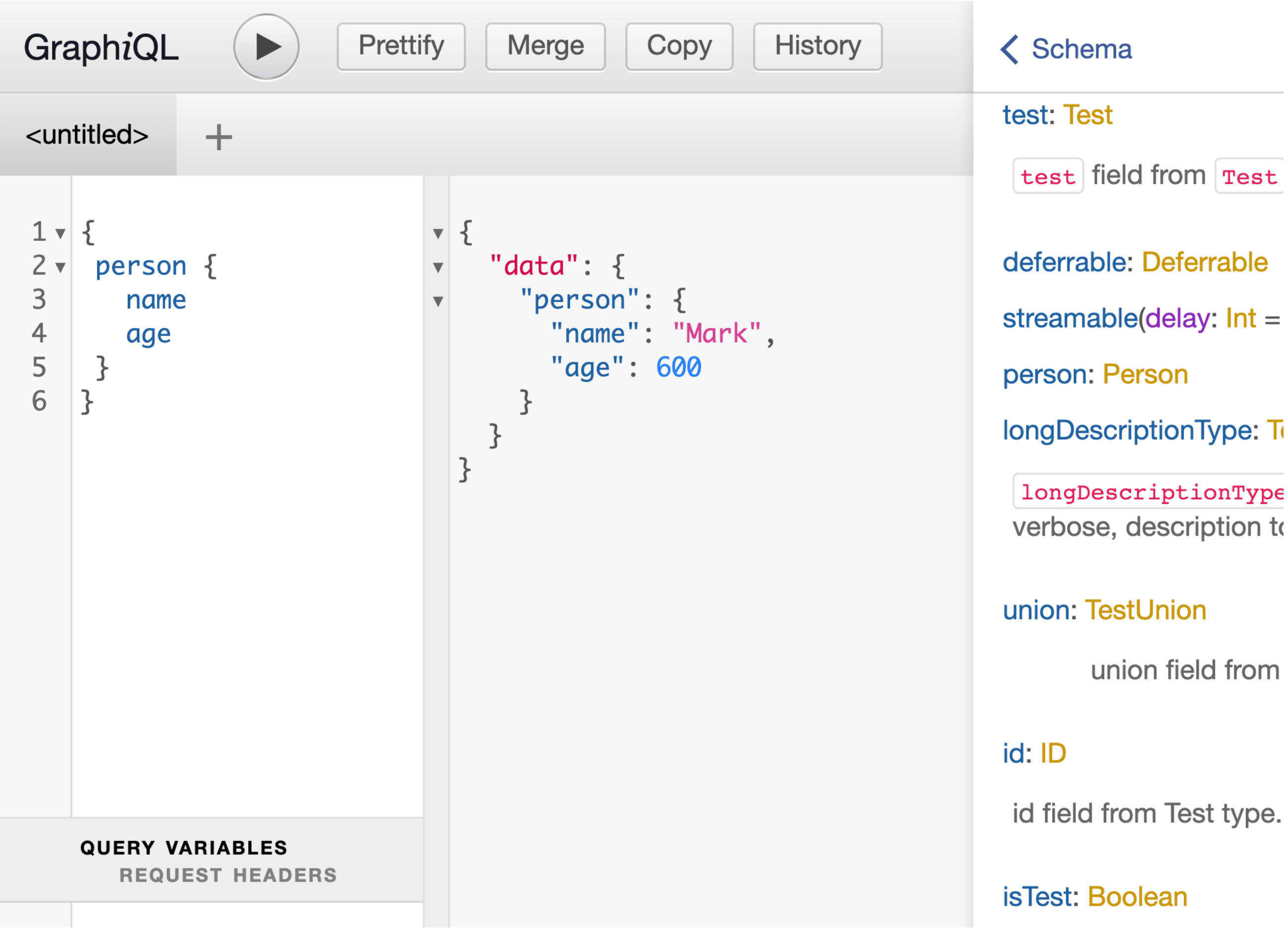
- GraphQL APIs are organized in terms of types and fields

```
Type Query {
  user : User
}
```

```
Type User {
  name : String
  age : Int
  friends: [User]
}
```

GraphiQL Tool

- Interactive GUI, IDE
- Runs in a browser
- Syntax highlighting
- Error reporting
- Automation and hinting



```
{
  person {
    name
    age
  }
}
```

```
{
  "data": {
    "person": {
      "name": "Mark",
      "age": 600
    }
  }
}
```

test: Test

test field from Test

deferrable: Deferrable

streamable(delay: Int =

person: Person

longDescriptionType: T

longDescriptionType verbose, description t

union: TestUnion

union field from

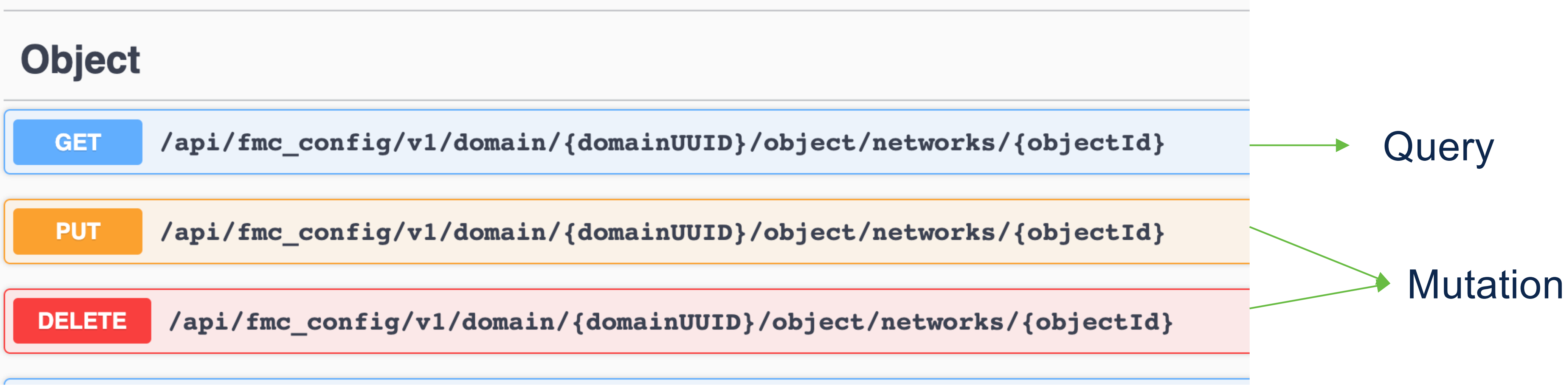
id: ID

id field from Test type.

isTest: Boolean

https://graphiql-test.netlify.app/?query=%7B%0A%20person%20%7B%0A%20%20%20name%0A%20%20%20age%0A%20%7D%0A%7D

Queries an API, not a database



Object

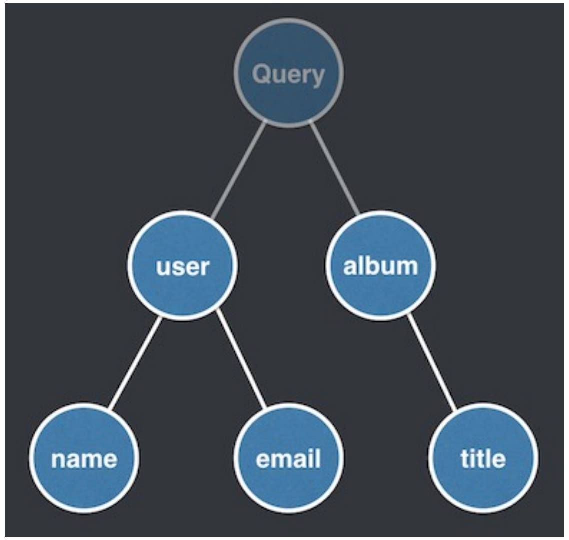
GET `/api/fmc_config/v1/domain/{domainUUID}/object/networks/{objectId}`

PUT `/api/fmc_config/v1/domain/{domainUUID}/object/networks/{objectId}`

DELETE `/api/fmc_config/v1/domain/{domainUUID}/object/networks/{objectId}`

Where is the graph?

```
type Query {
  _entities(representations: [_Any!]!): [_Entity]!
  _service: _Service!
  countries(filter: CountryFilterInput): [Country!]!
  country(code: ID!): Country
  continents(filter: ContinentFilterInput): [Continent!]!
  continent(code: ID!): Continent
  languages(filter: LanguageFilterInput): [Language!]!
  language(code: ID!): Language
}
```

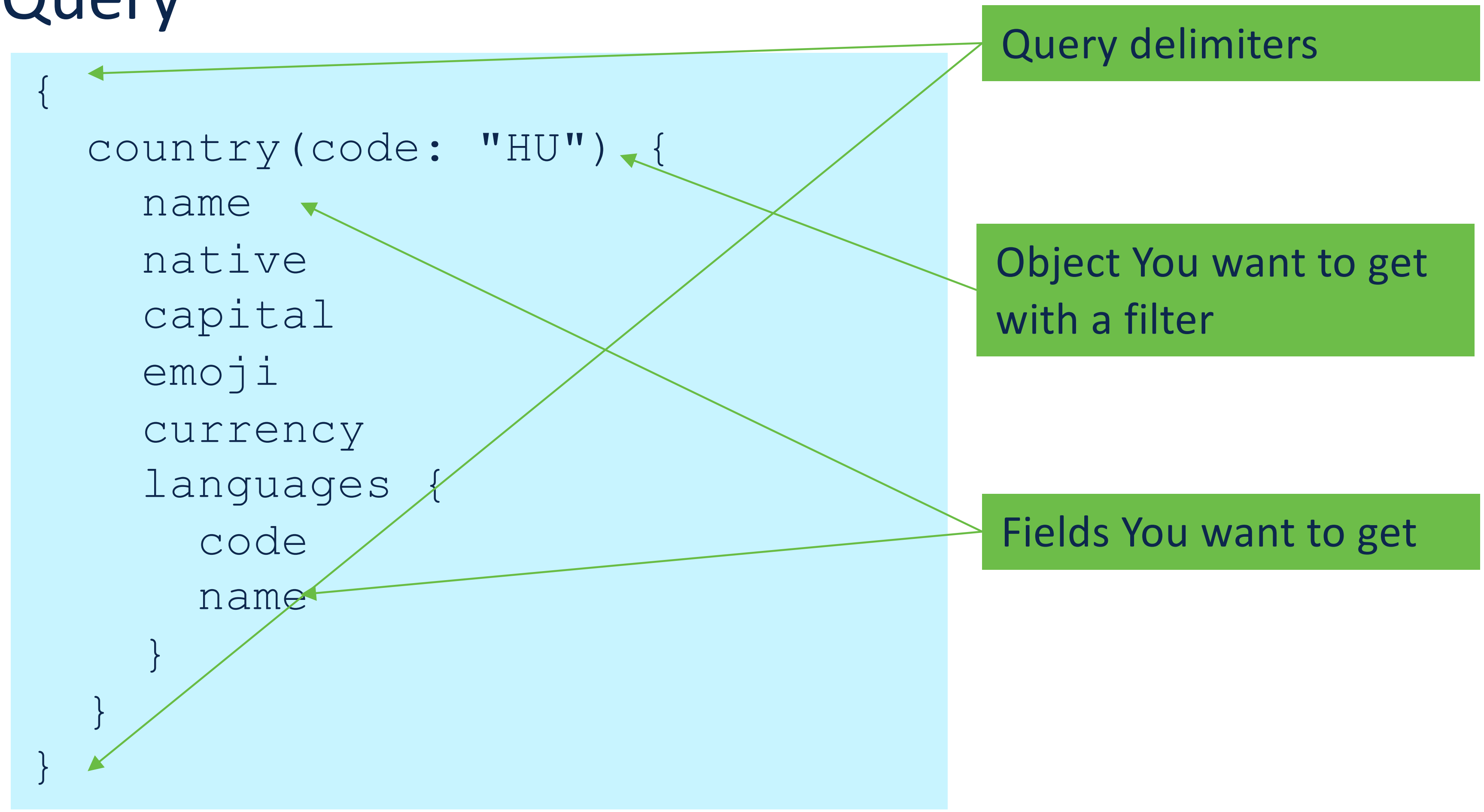


Type of an object

```
Type User {
  id : ID!
  name : String!
  age: Int!
  height: Float!
  isMarried: Boolean
  friends: [User]
}
```

- ! : manadatory elements
- [] : Type
- Basic types:
- ID, Int, String, Float, Boolean

Query



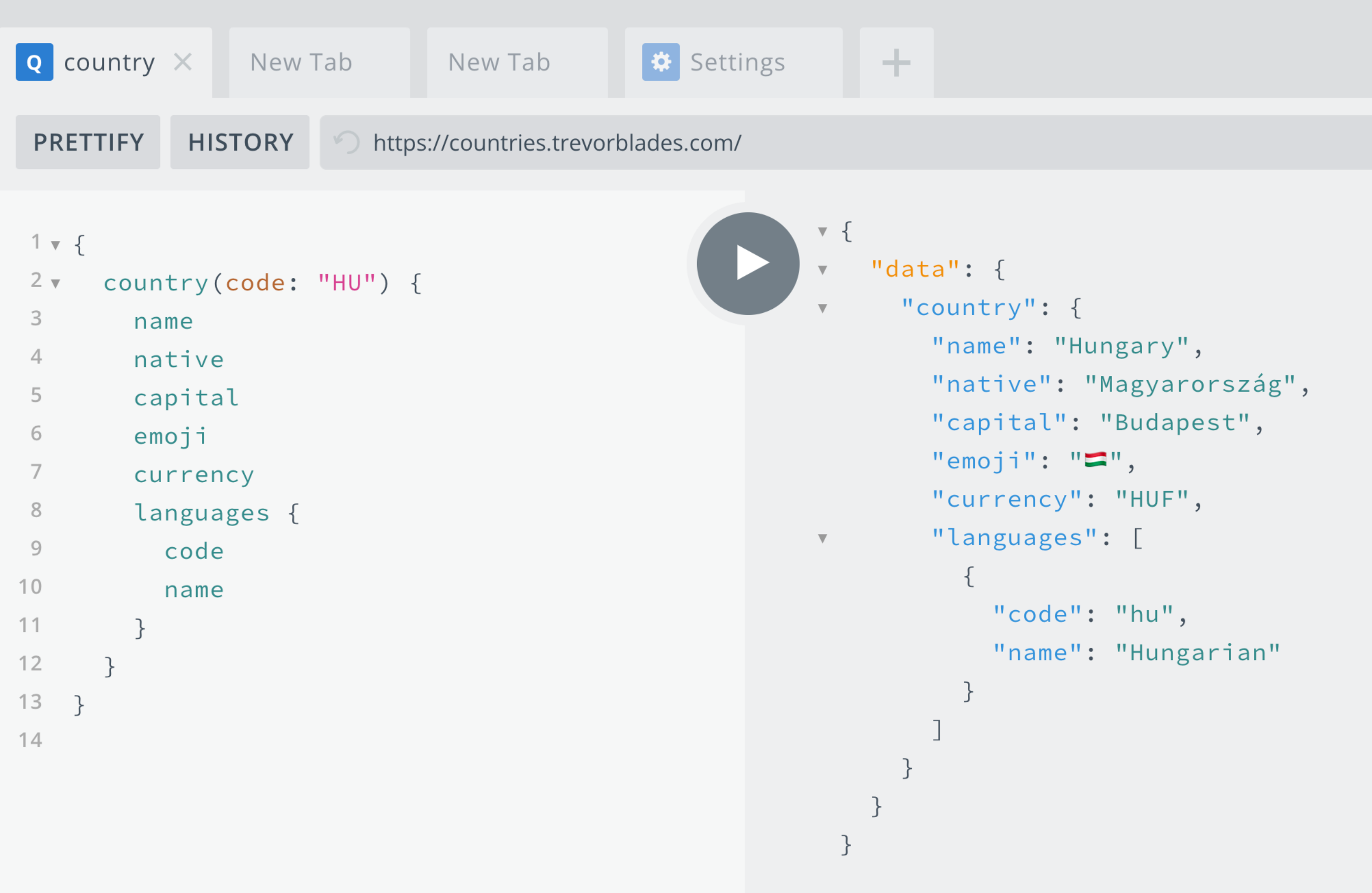
```
{
  country(code: "HU") {
    name
    native
    capital
    emoji
    currency
    languages {
      code
      name
    }
  }
}
```

Query delimiters

Object You want to get with a filter

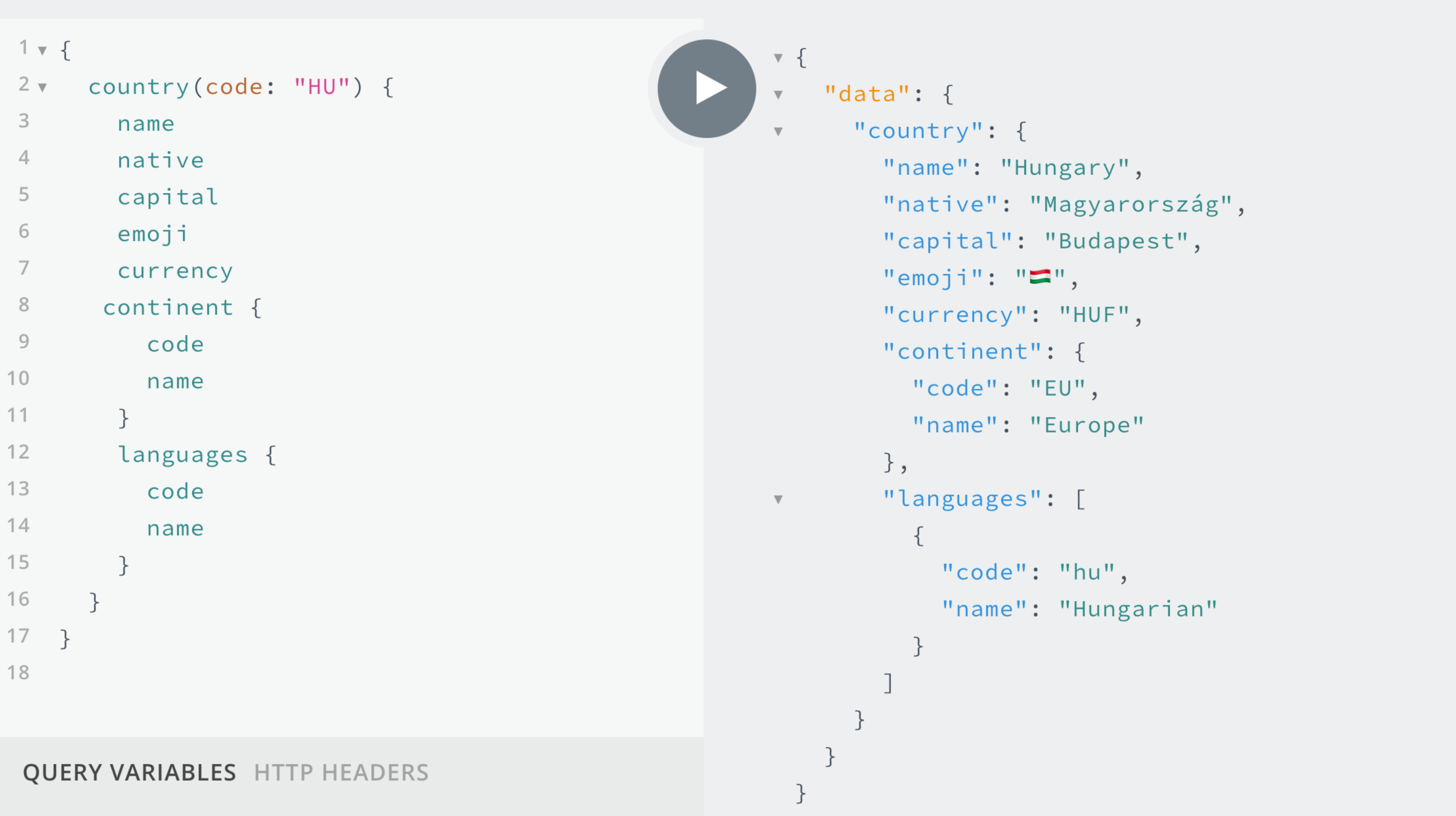
Fields You want to get

https://github.com/trevorblades/countries
https://countries.trevorblades.com/



```
{
  country(code: "HU") {
    name
    native
    capital
    emoji
    currency
    languages {
      code
      name
    }
  }
}
```

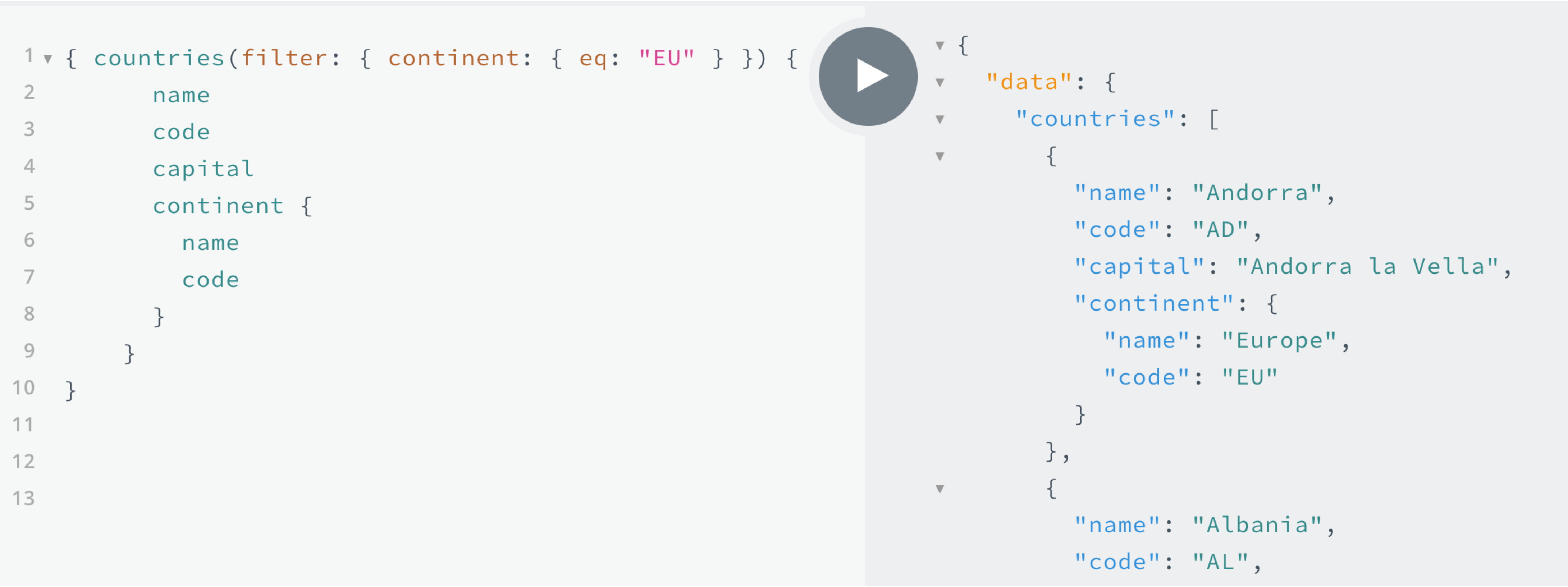
```
{
  "data": {
    "country": {
      "name": "Hungary",
      "native": "Magyarország",
      "capital": "Budapest",
      "emoji": "🇭🇺",
      "currency": "HUF",
      "languages": [
        {
          "code": "hu",
          "name": "Hungarian"
        }
      ]
    }
  }
}
```



```graphql
{
  country(code: "HU") {
    name
    native
    capital
    emoji
    currency
   continent {
      code
      name
    }
    languages {
      code
      name
    }
  }
}
```

```json
{
  "data": {
    "country": {
      "name": "Hungary",
      "native": "Magyarország",
      "capital": "Budapest",
      "emoji": "🇭🇺",
      "currency": "HUF",
      "continent": {
        "code": "EU",
        "name": "Europe"
      },
      "languages": [
        {
          "code": "hu",
          "name": "Hungarian"
        }
      ]
    }
  }
}
```

Filter "countries" based on "continent"



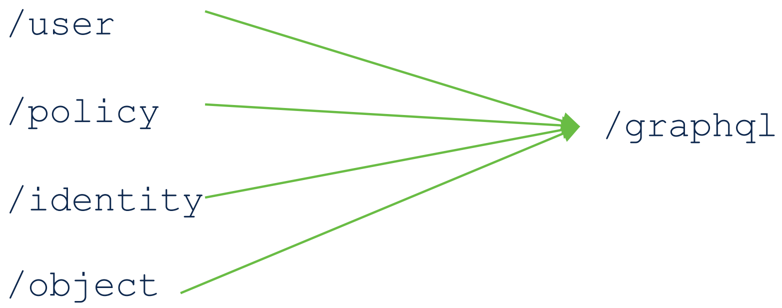
```
{ countries(filter: { continent: { eq: "EU" } }) {
      name
      code
      capital
      continent {
        name
        code
      }
    }
}
```

```
{
  "data": {
    "countries": [
      {
        "name": "Andorra",
        "code": "AD",
        "capital": "Andorra la Vella",
        "continent": {
          "name": "Europe",
          "code": "EU"
        }
      },
      {
        "name": "Albania",
        "code": "AL",
```

REST vs Graph

REST vs Graph

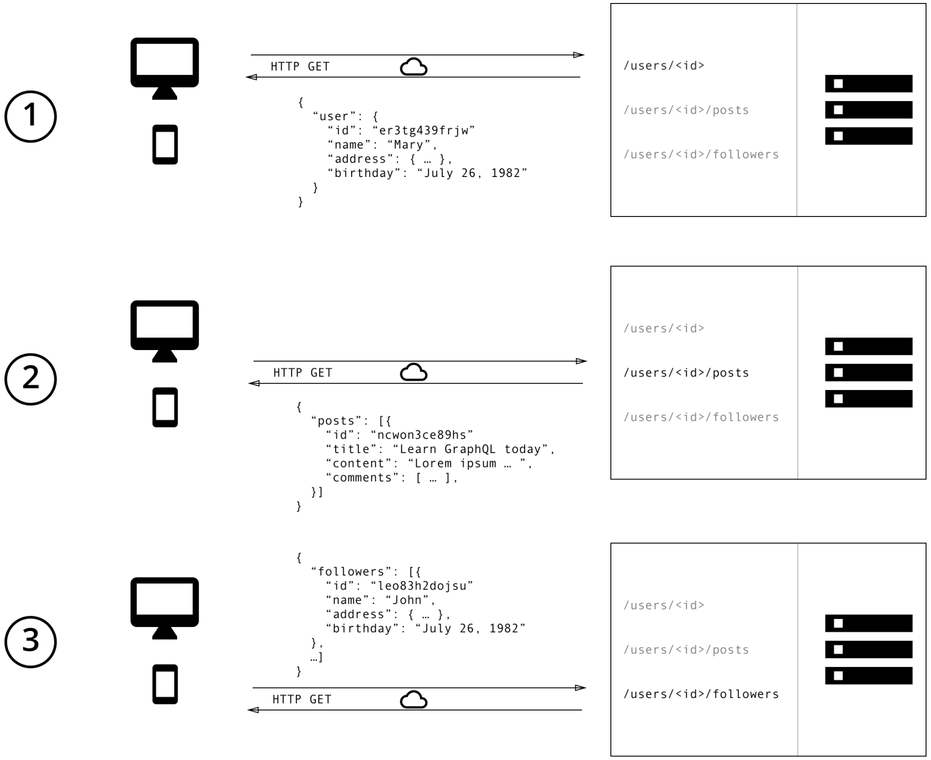
- One Endpoint



- Overfetching / underfetching

Data Fetching with REST :

- With a REST API, you would typically gather the data by accessing multiple endpoints.
- In the example, these could be /users/<id> endpoint to fetch the initial user data.
- Secondly, there’s likely to be a /users/<id>/postsendpoint that returns all the posts for a user.
- The third endpoint will then be the /users/<id>/followers that returns a list of followers per user.



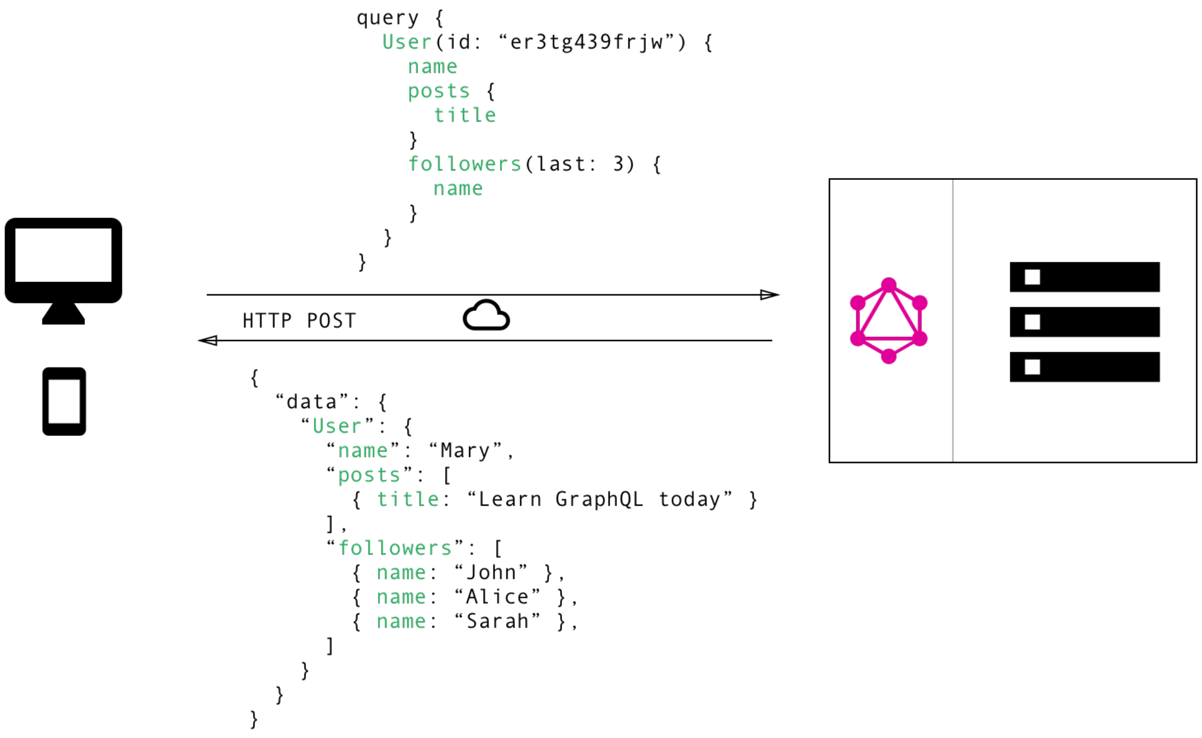
```
{
  “user”: {
    “id”: “er3tg439frjw”
    “name”: “Mary”,
    “address”: { … },
    “birthday”: “July 26, 1982”
  }
}
```

```
{
  “posts”: [{
    “id”: “ncwon3ce89hs”
    “title”: “Learn GraphQL today”,
    “content”: “Lorem ipsum … ”,
    “comments”: [ … ],
  }]
}
```

```
{
  “followers”: [{
    “id”: “leo83h2dojsu”
    “name”: “John”,
    “address”: { … },
    “birthday”: “July 26, 1982”
  },
  …]
}
```

DATA Fetching with GRAPHQL:

- In GraphQL on the other hand, you’d simply send a single query to the GraphQL server that includes the concrete data requirements.
- The server then responds with a JSON object where these requirements are fulfilled.



```
query {
  User(id: “er3tg439frjw”) {
    name
    posts {
      title
    }
    followers(last: 3) {
      name
    }
  }
}
```

```
{
  “data”: {
    “User”: {
      “name”: “Mary”,
      “posts”: [
        { title: “Learn GraphQL today” }
      ],
      “followers”: [
        { name: “John” },
        { name: “Alice” },
        { name: “Sarah” },
      ]
    }
  }
}
```

References

- https://countries.trevorblades.com/
- https://nainacodes.com/blog/intro-to-graphql-and-react-with-typescript
- https://blog.graphqleditor.com/best-graphql-apis-to-play-with
- https://graphql.org/code/#python
- https://medium.com/paypal-tech/graphql-resolvers-best-practices-cd36fdbcef55

Köszönöm!

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