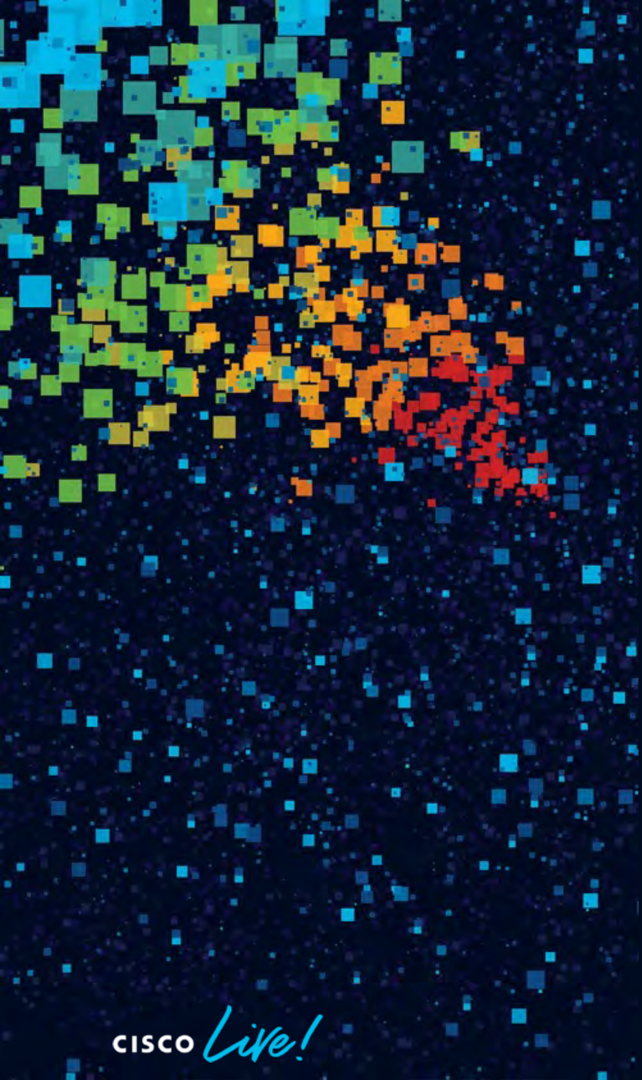
Possibilities

#CiscoLive | #DevNetDay

Coding 1001: REST APIs

HTTP for more than just web browsing

Matt DeNapoli – DevNet Developer Advocate
@theDeNap
DEVNET-1897



Agenda

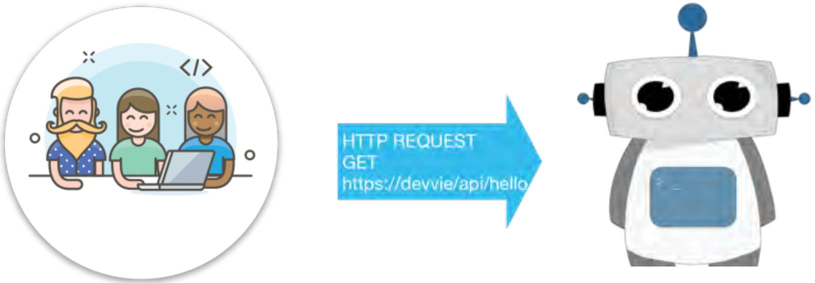
- REST
- Anatomy of a REST request
- Authorization
- Tools
- Real World
- Conclusion

REST

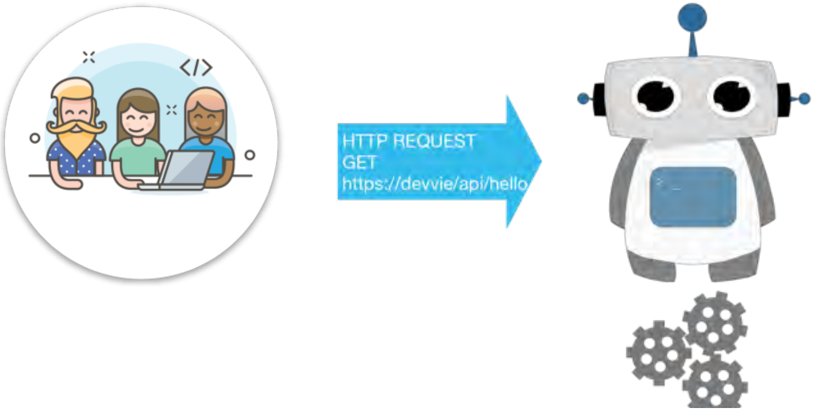
REST Web service

- What is REST?
  - REpresentational State Transfer (REST)
  - API framework built on HTTP
- What is a REST Web Service?
  - REST is *an architecture style* for designing networked applications.
  - Popular due to performance, scale, simplicity, and reliability

Request and Response, the REST API Flow

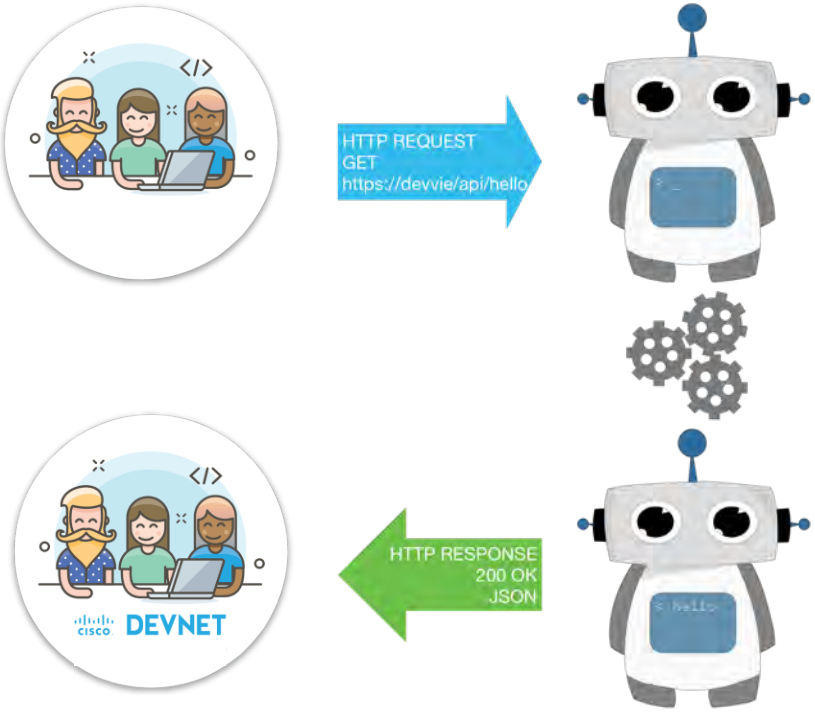


Requests and Response, the REST API Flow



HTTP REQUEST
GET
https://devvie/api/hello

Requests and Response, the REST API Flow



HTTP Methods: What to do?

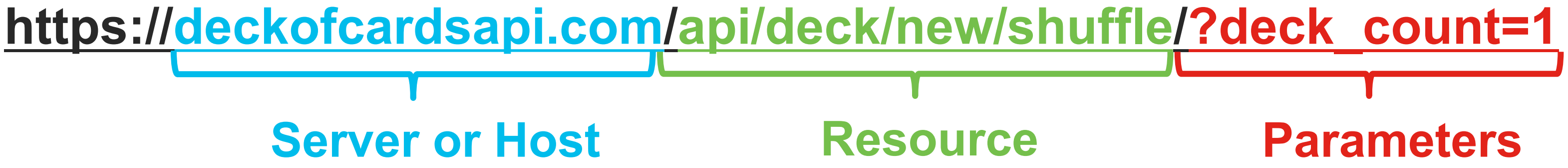
HTTP Verb	Typical Purpose (CRUD)	Description
POST	Create	Used to create a new object, or resource. Example: Add new book to library
GET	Read	Retrieve resource details from the system. Example: Get list of books from the library
PUT	Update	Typically used to replace or update a resource. Can be used to modify or create. Example: Update the borrower details for a book
PATCH	Update	Used to modify some details about a resource. Example: Change the author of a book
DELETE	Delete	Remove a resource from the system. Example: Delete a book from the library.

Response Status Codes: Did it work?

	Status Code	Status Message	Meaning
2xx	200	OK	All looks good
	201	Created	New resource created
	202	Accepted	Accepted for processing, but processing not completed
	204	No Content	Request succeeded, but no message body returned
4xx	400	Bad Request	Request was invalid
	401	Unauthorized	Authentication missing or incorrect
	403	Forbidden	Request was understood, but not allowed
	404	Not Found	Resource not found
5xx	500	Internal Server Error	Something wrong with the server
	503	Service Unavailable	Server is unable to complete request

Request Anatomy

The URI: What are you Requesting?



https://deckofcardsapi.com/api/deck/new/shuffle/?deck_count=1

Server or Host

Resource

Parameters

- http:// or https://
  - Protocol over which data is sent between client and server
  - ‘s’ in https stands for secure
- Server or Host
  - Resolves to the IP and port to which to connect
- Resource
  - The location of the data or object of interest
- Parameters
  - Details to scope, filter, or clarify a request. Often optional.

Data: Sending and Receiving

- Contained in the message body
- GET responses will include a message body
- POST, PUT, PATCH requests typically include a message body
- Format typically JSON or XML
  - Check “Content-Type” header

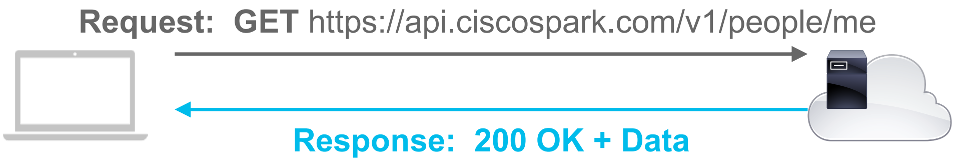
```
{
        "success": true,
        "deck_id": "3p40paa87x90",
        "shuffled": true,
        "remaining": 52
}
```

Headers:
What additional details and metadata can I use?

Header	Example Value	Purpose
Content-Type	application/json	Specify the format of the data in the body
Accept	application/json	Specify the requested format for returned data
Authorization	Basic dmFncmFudDp2YWdyYW50	Provide credentials to authorize a request
Date	Tue, 25 Jul 2017 19:26:00 GMT	Date and time of the message

- Used to pass information between client and server
- Included in both REQUEST and RESPONSE
- Some APIs use custom headers for authentication or other purpose

Review: Request/Response



Request: GET https://api.ciscospark.com/v1/people/me

Response: 200 OK + Data

HTTPS Request

```
GET /v1/people/me HTTPS/1.1
```

Request Headers

```
Host: api.ciscospark.com
Authorization: Bearer <redacted>
Accept: */*
Accept-Encoding: gzip, deflate, sdch
Connection: keep-alive
User-Agent: Mozilla/5.0 (Macintosh; Intel Mac OS X 10_11_4) AppleWebKit/537.36
(KHTML, like Gecko) Chrome/49.0.2623.112 Safari/537.36
```

HTTPS Response

```
HTTPS/1.1 200 OK
```

Response Headers

```
Date: Wed, 23 Jan 2019 23:12:11 GMT
Content-Type: application/json;charset=UTF-8
Content-Encoding: gzip
Content-Length: 323
Trackingid: ROUTER_5C48F4B1-9789-01BB-4148-xxxxxxxxx
Vary: Accept-Encoding
Strict-Transport-Security: max-age=63072000; includeSubDomains; preload
```

<blank line>

Response Payload

```
{
"id":
"Y2lzY29zcGFyazovL3VzL1BFT1BMRS9iODBjM2NmOC01ZGIwLTQyNzAtOThiZS1mYzFhYjA3MzE1YWE",
"emails": [”mdenapol@cisco.com"],
"displayName": ”Matt DeNapoli",
"nickName": ”Matthew",
"firstName": ”Matt",
"lastName": ”DeNapoli",
:
"status": "active",
"type": "person”
}
```

Note: This is all exchanged as simple text over a TCP/TLS connection.

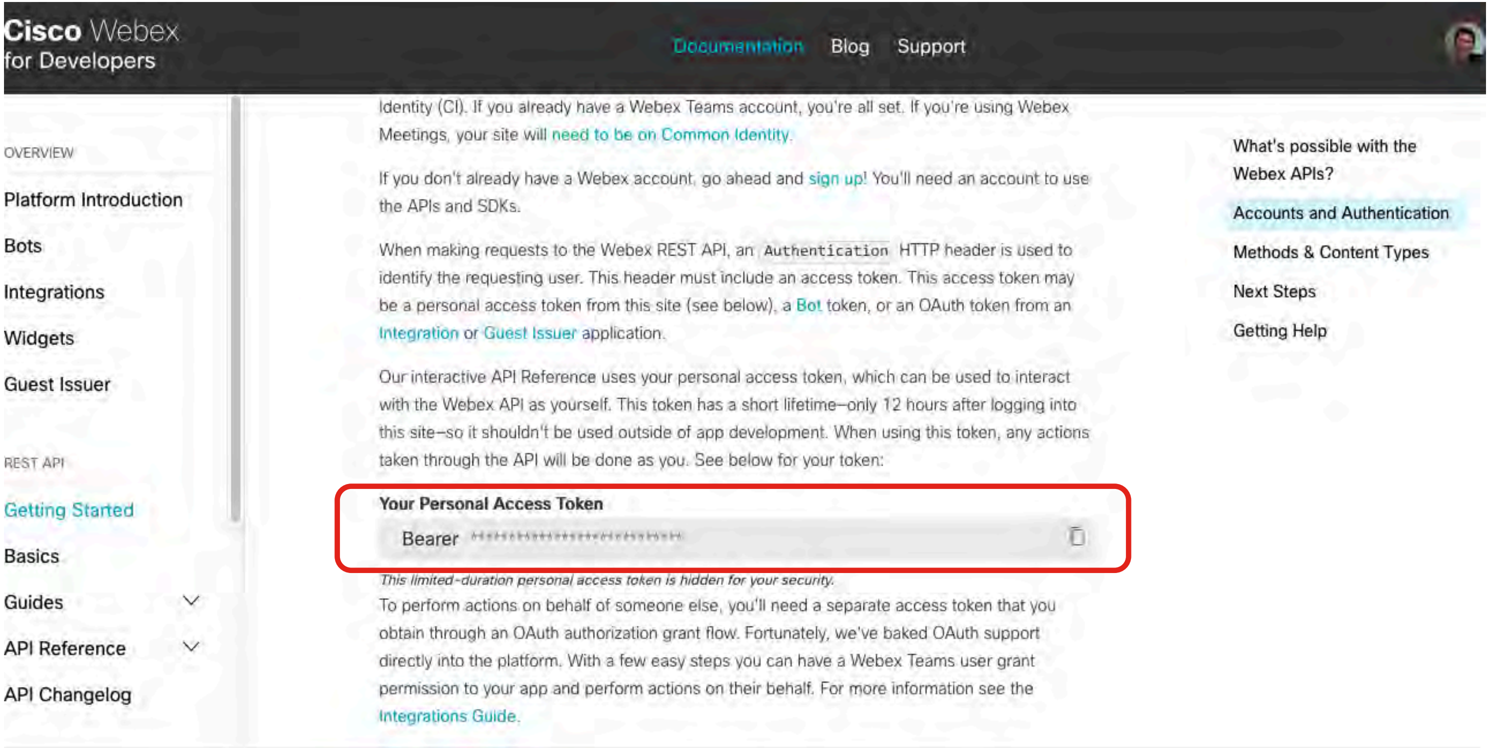
Authorization

HTTP Authentication and Security

- **None**: Web API resource is public, anybody can place requests
- **Syntax**
  - Authorization: <type> <credentials>
- **Basic**: username and password passed to server in encoded string
  - Authorization: Basic ENCODEDSTRING
- **OAuth**: Standard framework to retrieve access token from Identity Provider
  - Authorization: Bearer ENCODEDSTRING
- Authorization can be short-lived and require refreshing of token

Token example – Webex Teams

https://developer.webex.com/docs/api/getting-started/accounts-and-authentication



Identity (CI). If you already have a Webex Teams account, you're all set. If you're using Webex Meetings, your site will need to be on Common Identity.

If you don't already have a Webex account, go ahead and sign up! You'll need an account to use the APIs and SDKs.

When making requests to the Webex REST API, an `Authentication` HTTP header is used to identify the requesting user. This header must include an access token. This access token may be a personal access token from this site (see below), a Bot token, or an OAuth token from an Integration or Guest Issuer application.

Our interactive API Reference uses your personal access token, which can be used to interact with the Webex API as yourself. This token has a short lifetime–only 12 hours after logging into this site–so it shouldn't be used outside of app development. When using this token, any actions taken through the API will be done as you. See below for your token:

Your Personal Access Token

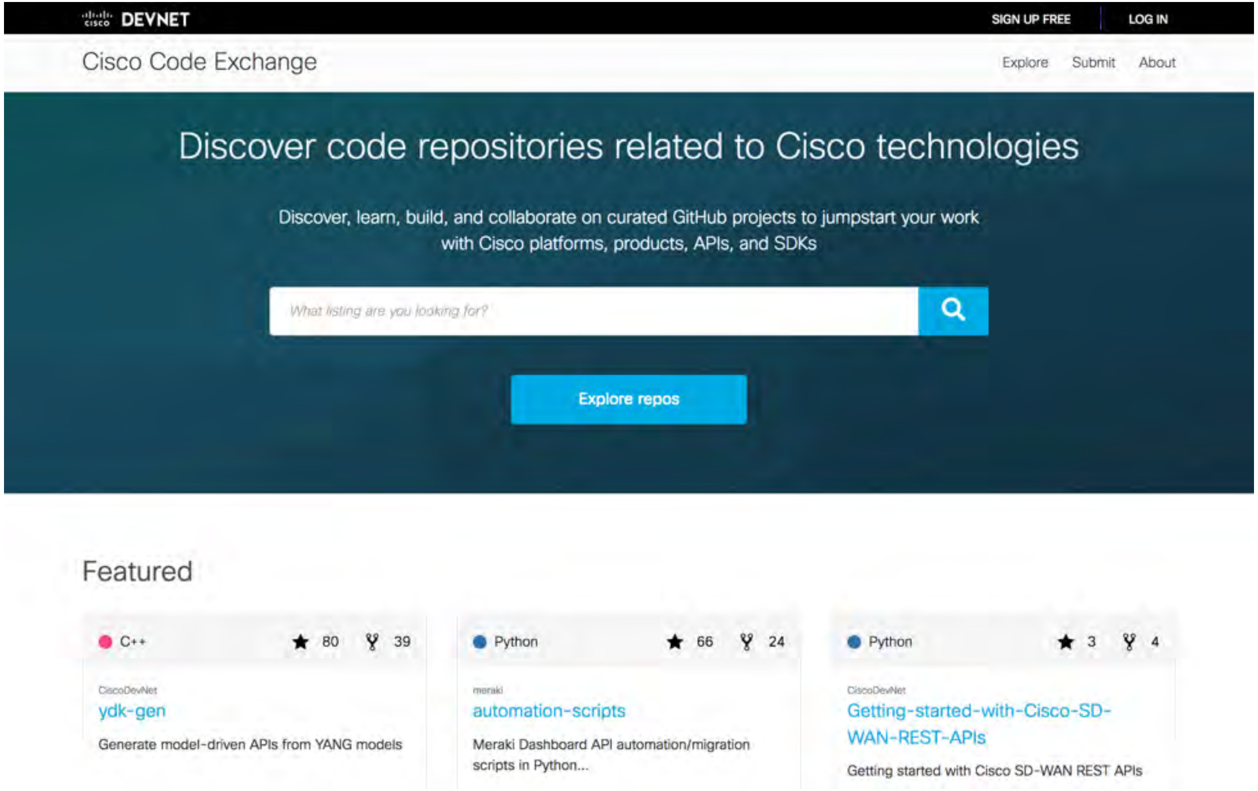
Bearer ****************************

This limited-duration personal access token is hidden for your security.

To perform actions on behalf of someone else, you'll need a separate access token that you obtain through an OAuth authorization grant flow. Fortunately, we've baked OAuth support directly into the platform. With a few easy steps you can have a Webex Teams user grant permission to your app and perform actions on their behalf. For more information see the Integrations Guide.

OAuth example: Code Exchange

https://developer.cisco.com/codeexchange/



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Discover, learn, build, and collaborate on curated GitHub projects to jumpstart your work with Cisco platforms, products, APIs, and SDKs

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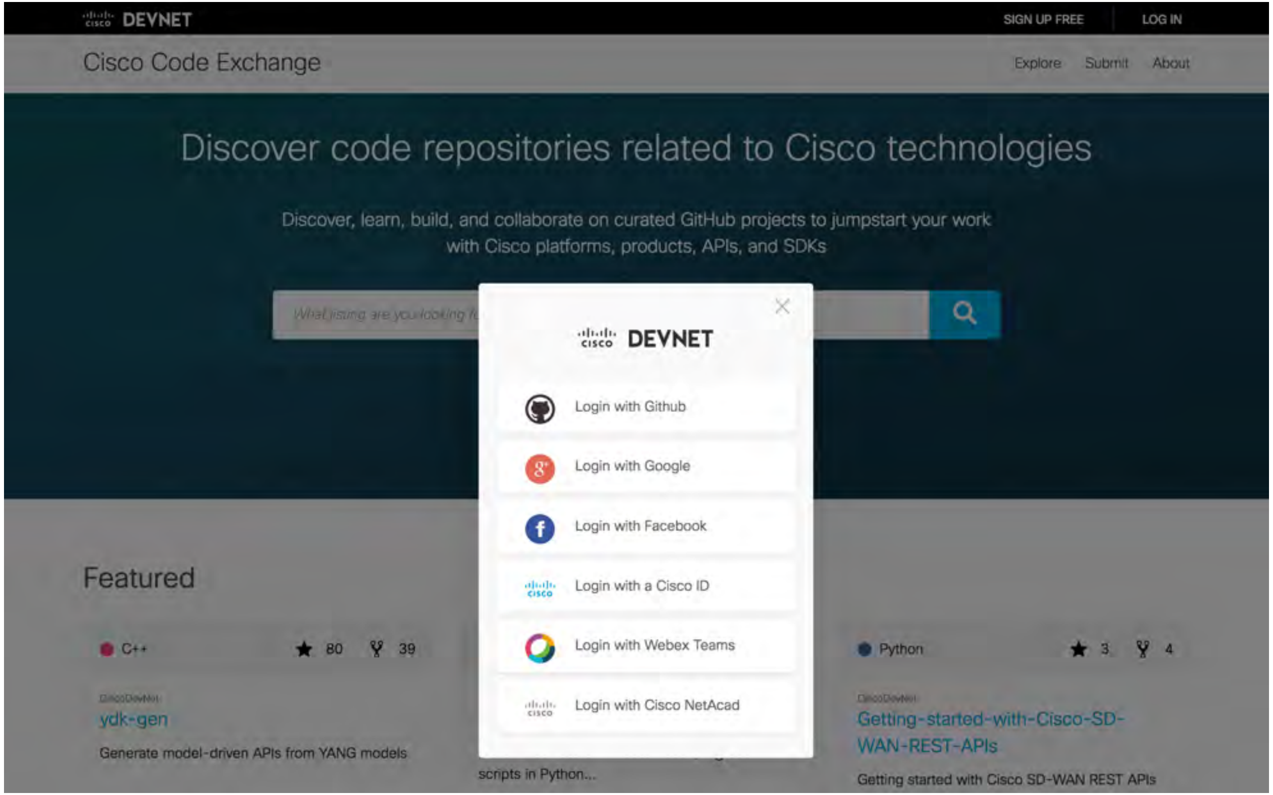
OAuth example: Code Exchange

https://developer.cisco.com/codeexchange/



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ydk-gen

Generate model-driven APIs from YANG models

scripts in Python...

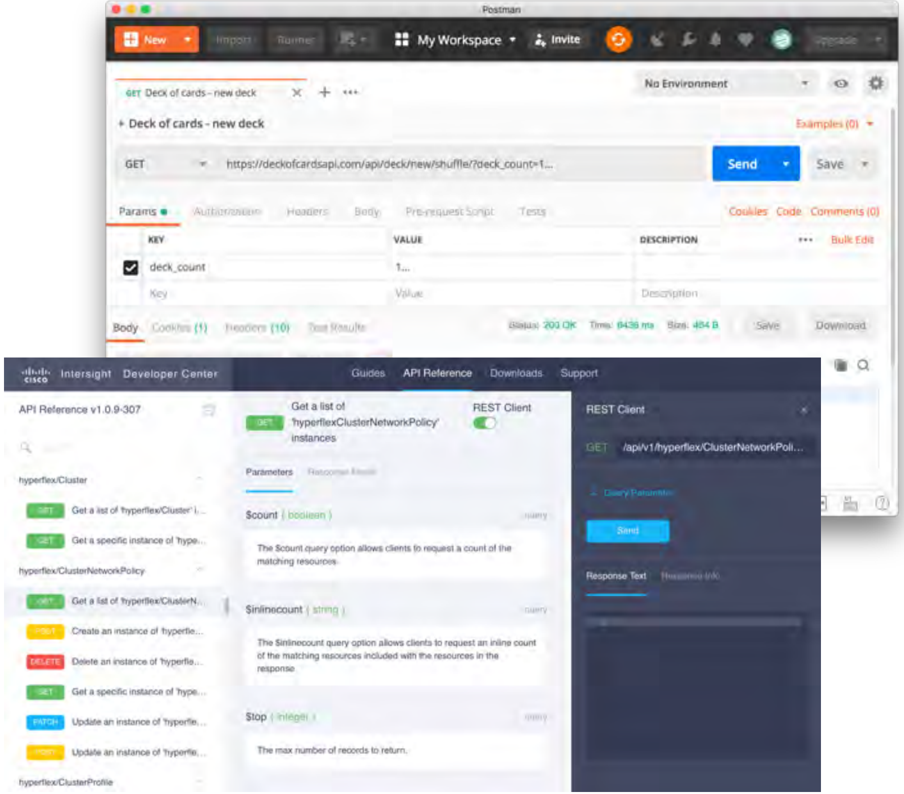
Getting-started-with-Cisco-SD-WAN-REST-APIs

Getting started with Cisco SD-WAN REST APIs

Tools

Many Options for Working with REST APIs

- Web browser
  - Chrome, Firefox, etc.
- curl
  - Linux command line application
- Postman
  - API testing application and framework
- Requests
  - Python library for scripting
- OpenAPI/Swagger
  - Dynamic API Documentation



GET https://deckofcardsapi.com/api/deck/new/shuffle/?deck_count=1...

☑ deck_count 1...

Status: 200 OK Time: 8436 ms Size: 484 B

GET Get a list of 'hyperflex/Cluster' i...

GET Get a specific instance of 'hype...

GET Get a list of 'hyperflex/ClusterN...

POST Create an instance of 'hyperfle...

DELETE Delete an instance of 'hyperfle...

GET Get a specific instance of 'hype...

PATCH Update an instance of 'hyperfle...

POST Update an instance of 'hyperfle...

GET Get a list of 'hyperflexClusterNetworkPolicy' instances

$count (boolean)

The $count query option allows clients to request a count of the matching resources

$inlinecount (string)

The $inlinecount query option allows clients to request an inline count of the matching resources included with the resources in the response

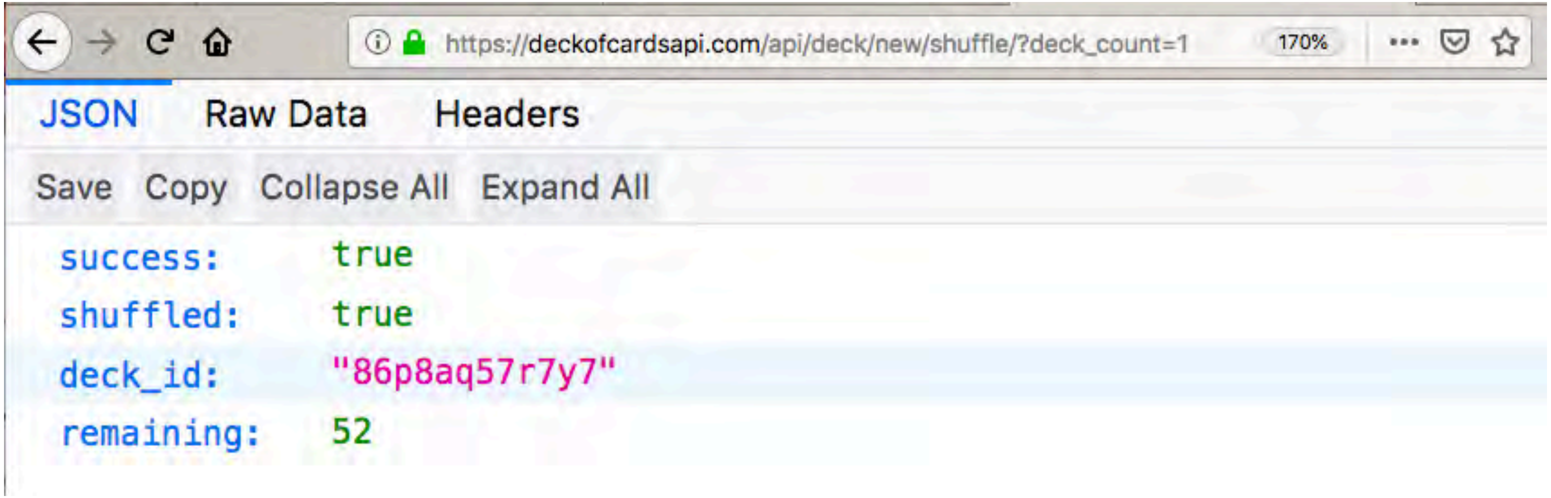
$top (integer)

The max number of records to return.

GET /api/v1/hyperflex/ClusterNetworkPoli...

Web Browser

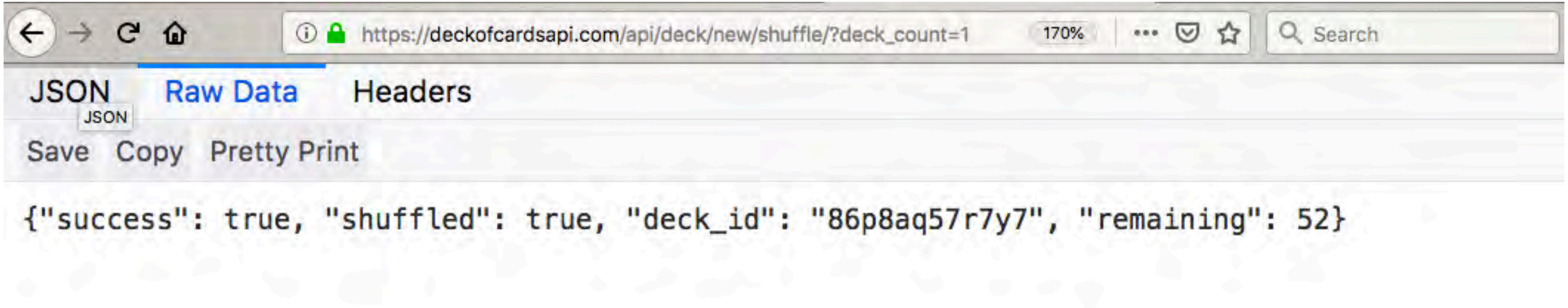
https://deckofcardsapi.com/api/deck/new/shuffle/?deck_count=1


https://deckofcardsapi.com/api/deck/new/shuffle/?deck_count=1
170%
JSON
Raw Data
Headers
Save
Copy
Collapse All
Expand All

```
success:     true
shuffled:    true
deck_id:     "86p8aq57r7y7"
remaining:   52
```

Web Browser

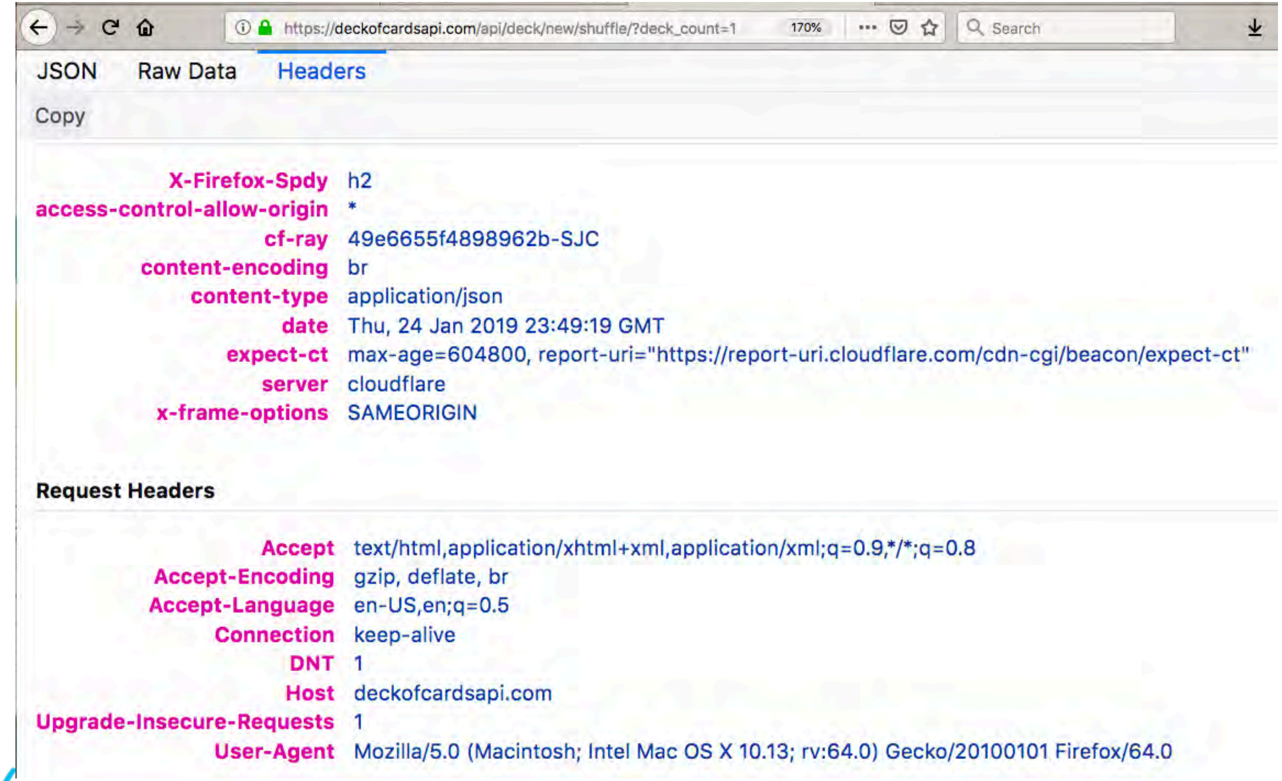
https://deckofcardsapi.com/api/deck/new/shuffle/?deck_count=1


https://deckofcardsapi.com/api/deck/new/shuffle/?deck_count=1
170%
Search
JSON
Raw Data
Headers
JSON
Save
Copy
Pretty Print

```
{"success": true, "shuffled": true, "deck_id": "86p8aq57r7y7", "remaining": 52}
```

Web Browser

https://deckofcardsapi.com/api/deck/new/shuffle/?deck_count=1



https://deckofcardsapi.com/api/deck/new/shuffle/?deck_count=1
170%
Search
JSON
Raw Data
Headers
Copy

```
             X-Firefox-Spdy  h2
access-control-allow-origin  *
                     cf-ray  49e6655f4898962b-SJC
           content-encoding  br
               content-type  application/json
                       date  Thu, 24 Jan 2019 23:49:19 GMT
                  expect-ct  max-age=604800, report-uri="https://report-uri.cloudflare.com/cdn-cgi/beacon/expect-ct"
                     server  cloudflare
            x-frame-options  SAMEORIGIN
```

Request Headers

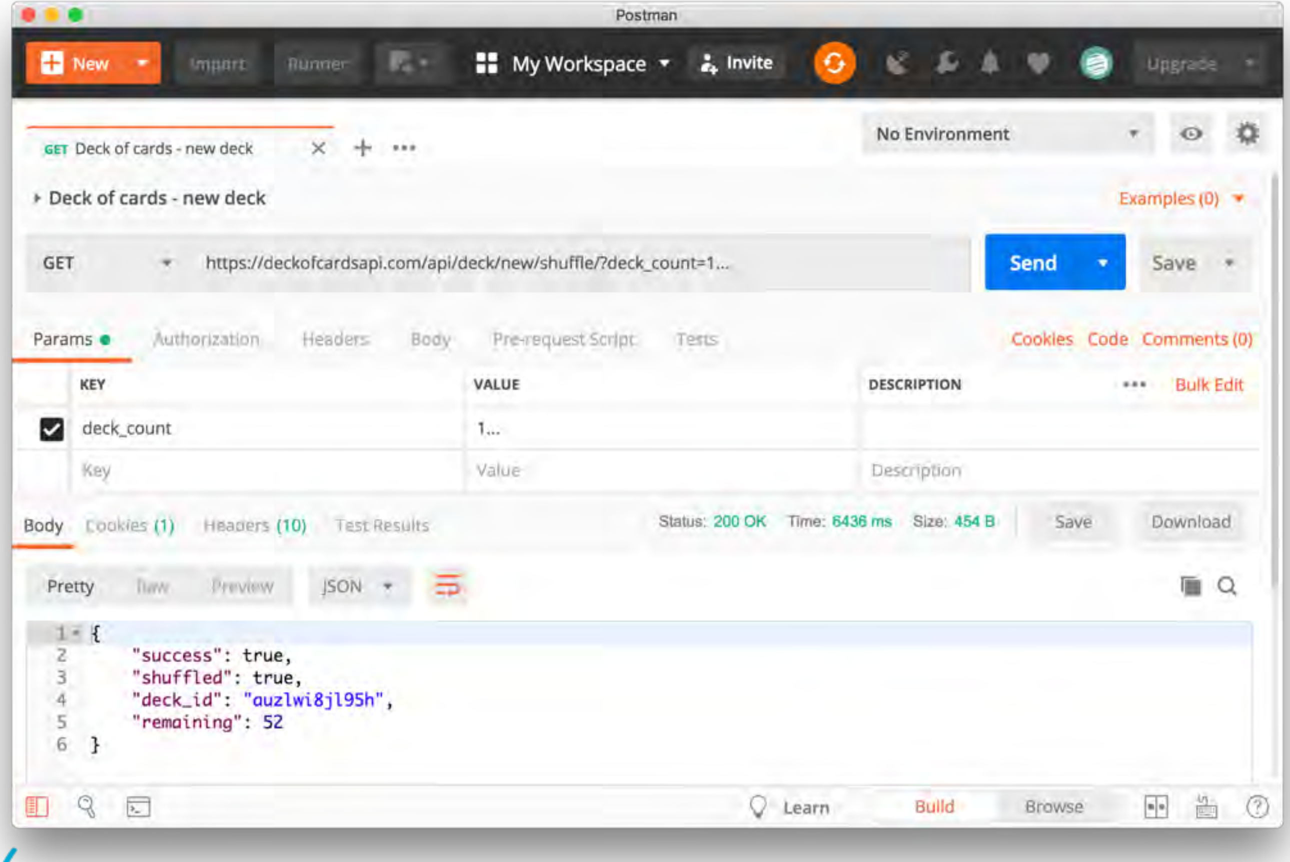
```
                   Accept  text/html,application/xhtml+xml,application/xml;q=0.9,*/*;q=0.8
          Accept-Encoding  gzip, deflate, br
          Accept-Language  en-US,en;q=0.5
               Connection  keep-alive
                      DNT  1
                     Host  deckofcardsapi.com
Upgrade-Insecure-Requests  1
               User-Agent  Mozilla/5.0 (Macintosh; Intel Mac OS X 10.13; rv:64.0) Gecko/20100101 Firefox/64.0
```

curl

```
$ curl
https://deckofcardsapi.com/api/deck/new/shuffle/?deck_count=1
```

```
{"success": true, "shuffled": true, "deck_id": "sr405eihisjl",
"remaining": 52}
```

Postman



GET Deck of cards - new deck

Deck of cards - new deck

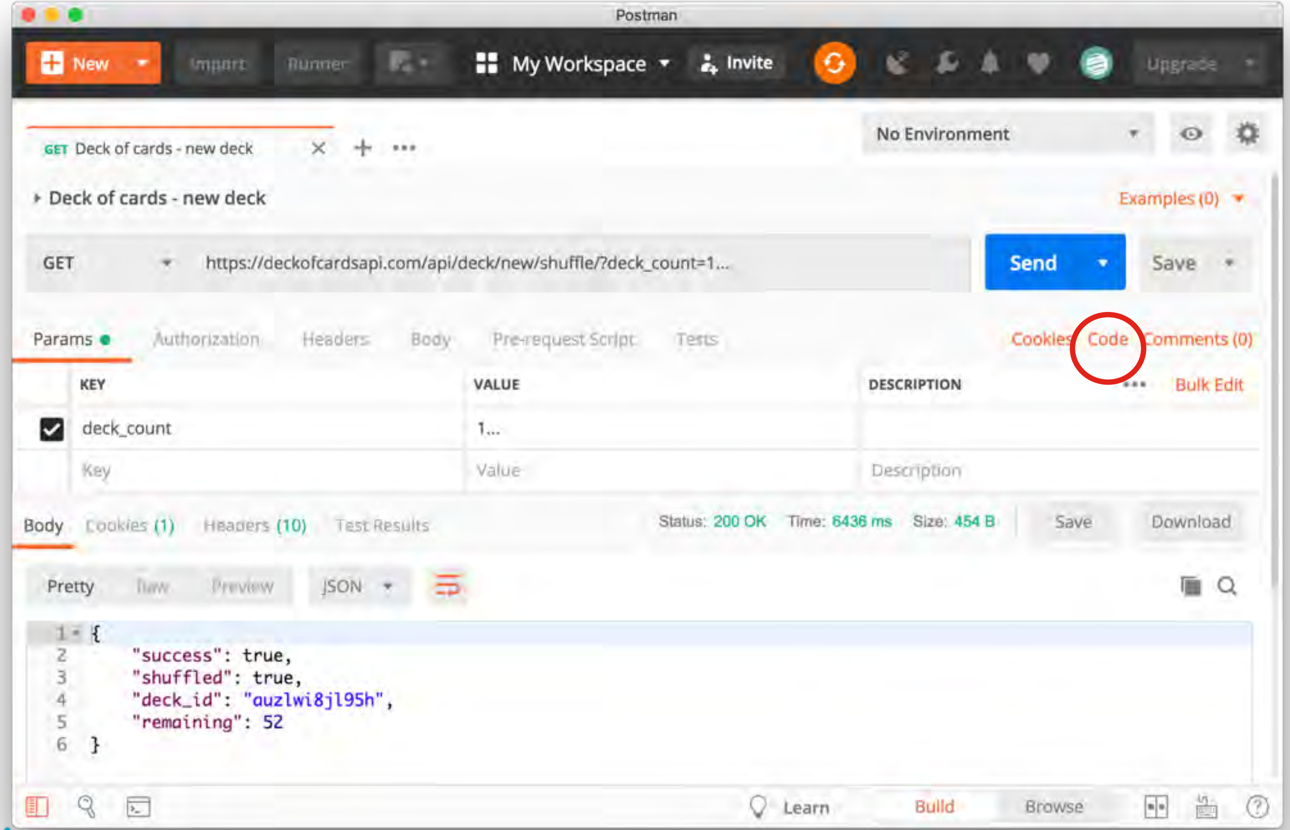
GET https://deckofcardsapi.com/api/deck/new/shuffle/?deck_count=1...

	KEY	VALUE	DESCRIPTION
☑	deck_count	1...	
	Key	Value	Description

Status: 200 OK Time: 6436 ms Size: 454 B

```
{
    "success": true,
    "shuffled": true,
    "deck_id": "auzlwi8jl95h",
    "remaining": 52
}
```

Postman



Deck of cards - new deck

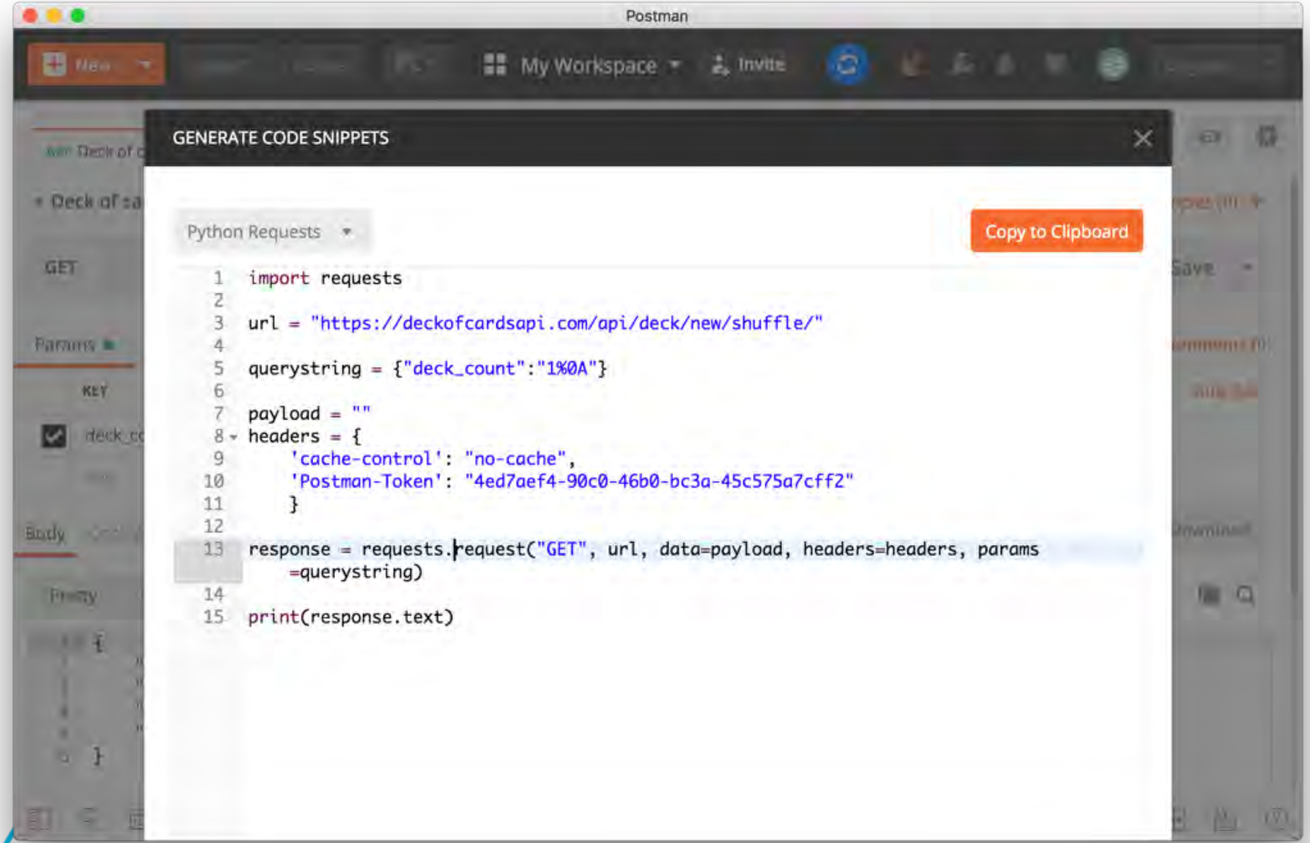
GET https://deckofcardsapi.com/api/deck/new/shuffle/?deck_count=1...

KEY	VALUE	DESCRIPTION
☑ deck_count	1...	
Key	Value	Description

Body — Status: 200 OK Time: 6436 ms Size: 454 B

```
{
    "success": true,
    "shuffled": true,
    "deck_id": "auzlwi8jl95h",
    "remaining": 52
}
```

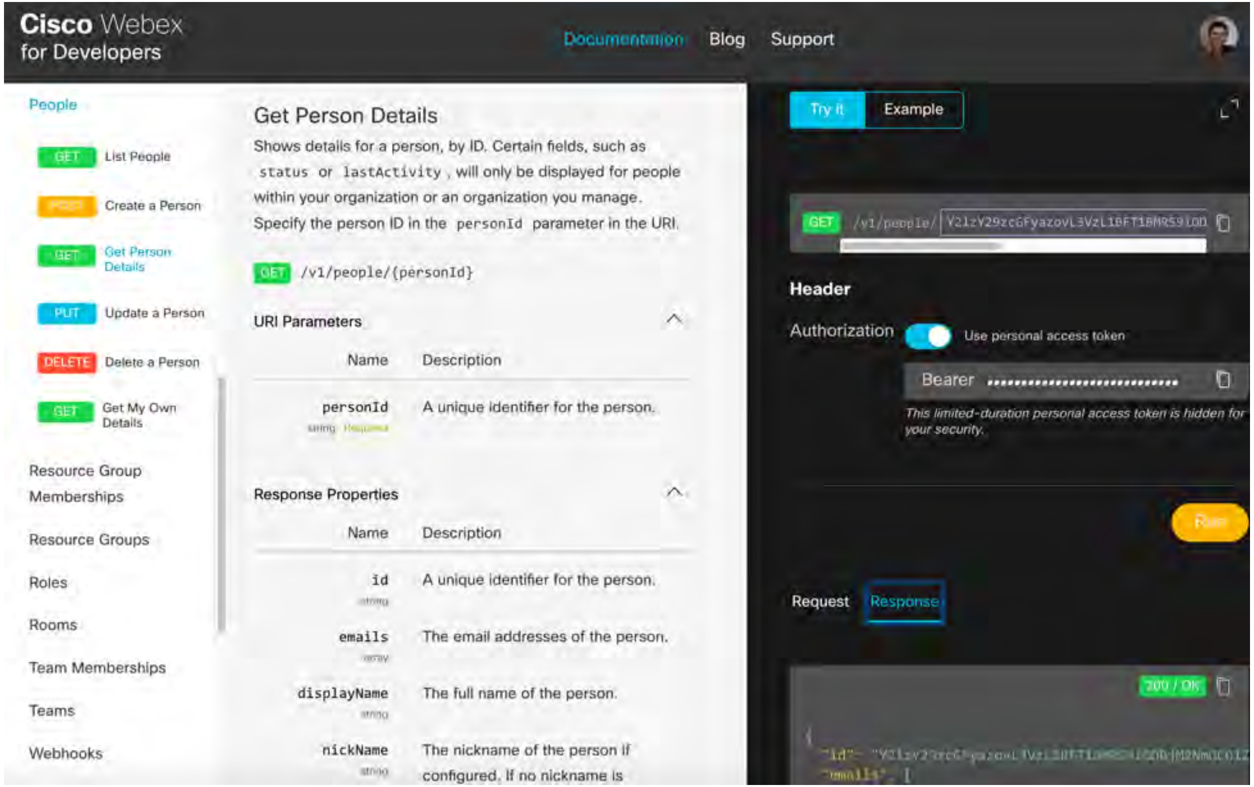
Python



```python
import requests

url = "https://deckofcardsapi.com/api/deck/new/shuffle/"

querystring = {"deck_count":"1%0A"}

payload = ""
headers = {
    'cache-control': "no-cache",
    'Postman-Token': "4ed7aef4-90c0-46b0-bc3a-45c575a7cff2"
    }

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

print(response.text)
```

OpenAPI example: Webex Teams

https://developer.webex.com/docs/api/v1/people/get-person-details



Get Person Details

Shows details for a person, by ID. Certain fields, such as `status` or `lastActivity`, will only be displayed for people within your organization or an organization you manage. Specify the person ID in the `personId` parameter in the URI.

```
GET /v1/people/{personId}
```

URI Parameters

Name	Description
`personId` string Required	A unique identifier for the person.

Response Properties

Name	Description
`id` string	A unique identifier for the person.
`emails` array	The email addresses of the person.
`displayName` string	The full name of the person.
`nickName` string	The nickname of the person if configured. If no nickname is

```
GET /v1/people/ Y2lzY29zcGFyazovL3VzL1BFT1BMRS91OD
```

Header

Authorization ● Use personal access token

Bearer ••••••••••••••••••••••••••••••

This limited-duration personal access token is hidden for your security.

```
{
  "id": "Y2lzY29zcGFyazovL3VzL1BFT1BMRS91ODhjM2NmOC01Z
  "emails": [
```

Requests in the Real World

Network Programmability with RESTCONF

Version 16.8

NETCONF/YANG and RESTCONF

On IOS XE

NETCONF-YANG and RESTCONF ...

Get hands on with Model Driven Programmability using

ALWAYS-ON

The Request

```
$ curl -vk \
  -u root:D_Vay\!_10\& \
  -H 'accept: application/yang-data+json' \
https://ios-xe-mgmt.cisco.com:9443/restconf/data/ietf-interfaces:interfaces/interface=GigabitEthernet1

> GET /restconf/data/ietf-interfaces:interfaces/interface=GigabitEthernet1 HTTP/1.1
> Host: ios-xe-mgmt.cisco.com:9443
> Authorization: Basic cm9vdDpEX1ZheSFfMTAm
> User-Agent: curl/7.54.0
> accept: application/yang-data+json
>
```

- -u provides `user:password` for Basic Authentication
- -H to set headers
- Lines beginning with “>” indicate Request elements
- Lines beginning with “<” indicate Response elements (next slide)

Network Programmability with RESTCONF

Version 16.8

NETCONF/YANG and RESTCONF

On IOS XE

NETCONF-YANG and RESTCONF ...

Get hands on with Model Driven Programmability using

ALWAYS-ON

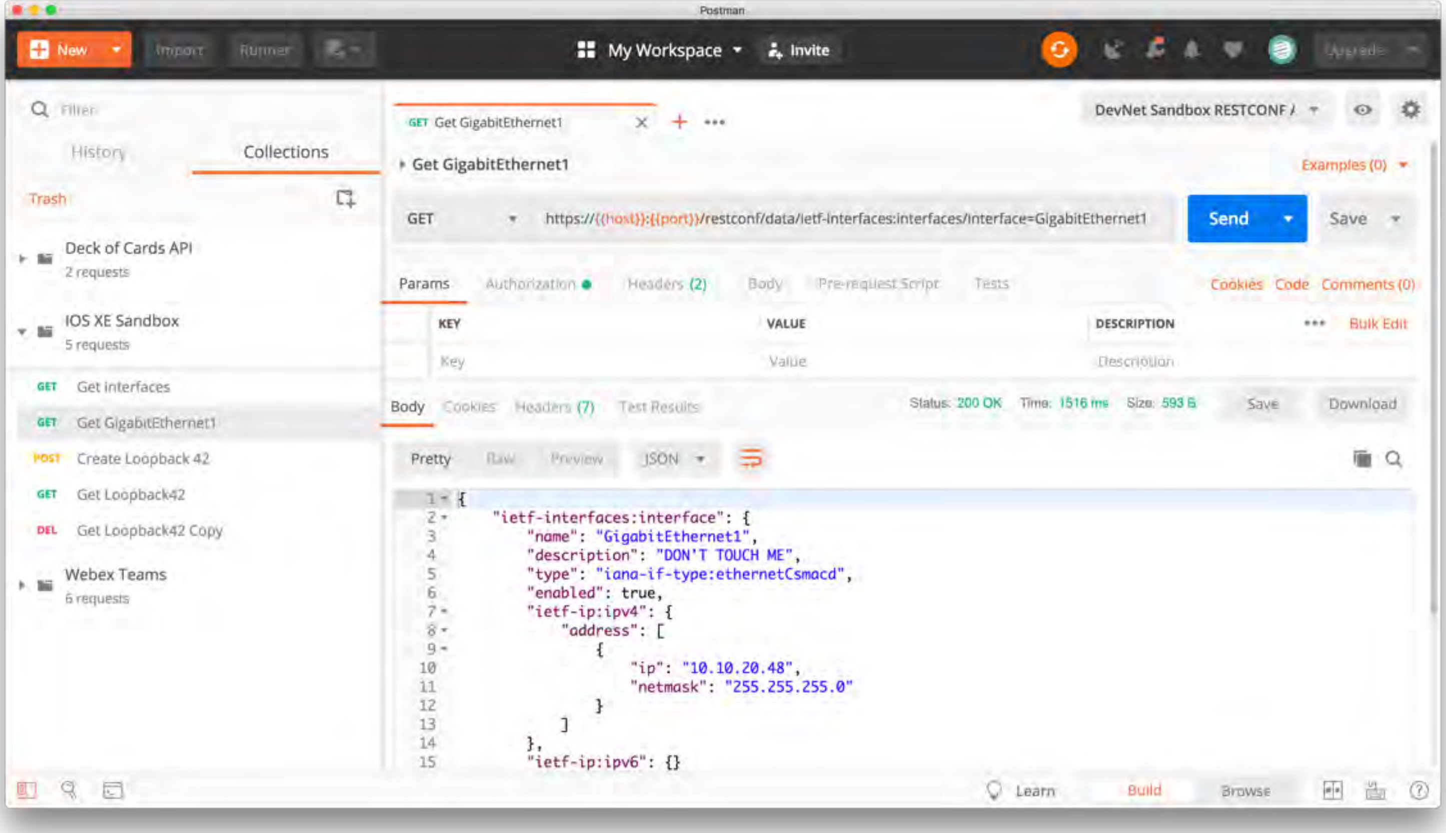
The Response - Headers

```
< HTTP/1.1 200 OK
< Server: nginx
< Date: Fri, 25 Jan 2019 17:37:43 GMT
< Content-Type: application/yang-data+json
< Transfer-Encoding: chunked
< Connection: close
< Cache-Control: private, no-cache, …
< Pragma: no-cache
<
```

The Response - Body

```
{
  "ietf-interfaces:interface": {
    "name": "GigabitEthernet1",
    "description": "DON'T TOUCH ME",
    "type": "iana-if-type:ethernetCsmacd",
    "enabled": true,
    "ietf-ip:ipv4": {
      "address": [
        {
          "ip": "10.10.20.48",
          "netmask": "255.255.255.0"
        }
      ]
    },
    "ietf-ip:ipv6": {
    }
  }
}
```

Postman Collections and Environments



Deck of Cards API
2 requests

IOS XE Sandbox
5 requests

- GET Get interfaces
- GET Get GigabitEthernet1
- POST Create Loopback 42
- GET Get Loopback42
- DEL Get Loopback42 Copy

Webex Teams
6 requests

GET Get GigabitEthernet1

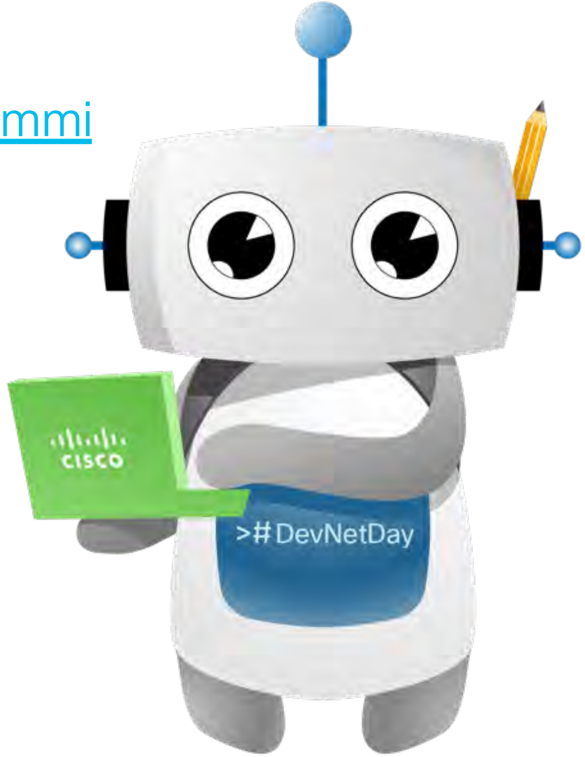
```
GET https://{{host}}:{{port}}/restconf/data/ietf-interfaces:interfaces/interface=GigabitEthernet1
```

Status: 200 OK Time: 1516 ms Size: 593 B

```
{
    "ietf-interfaces:interface": {
        "name": "GigabitEthernet1",
        "description": "DON'T TOUCH ME",
        "type": "iana-if-type:ethernetCsmacd",
        "enabled": true,
        "ietf-ip:ipv4": {
            "address": [
                {
                    "ip": "10.10.20.48",
                    "netmask": "255.255.255.0"
                }
            ]
        },
        "ietf-ip:ipv6": {}
```

Explore More

- Programming Fundamentals: https://developer.cisco.com/learning/modules/programming-fundamentals



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Possibilities

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