Planet of the APIs

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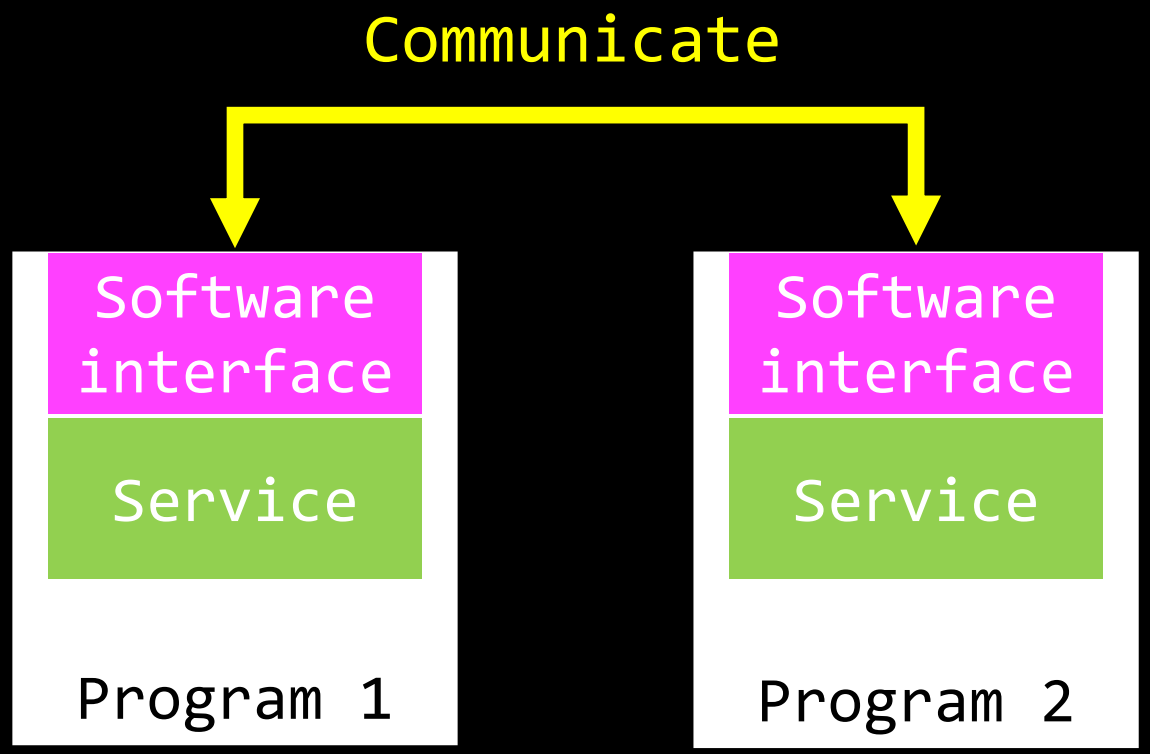
What are APIs

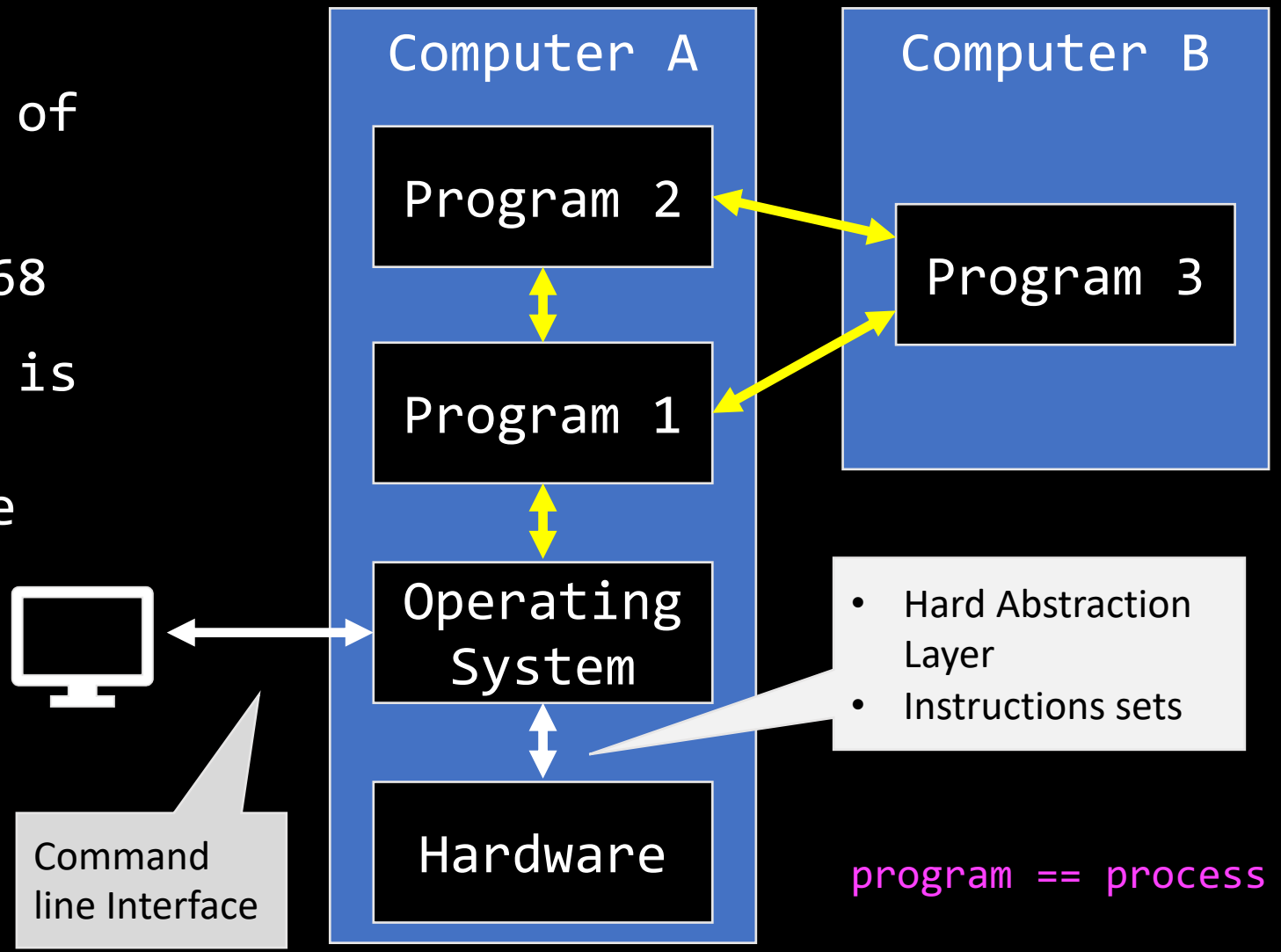
Wikipedia:

An application programming interface (API) is a way for two or more computer programs to communicate with each other. It is a type of software interface, offering a service to other pieces of software.



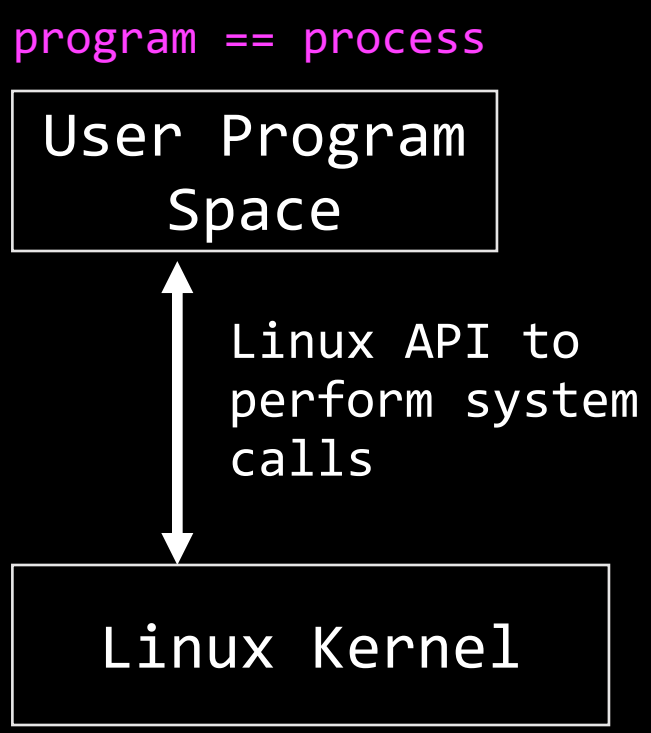
Evolution of APIs

- The concept of API was conceived since the time of sub-routines
- Term was conceived in 1968
- At the lowest level APIs is the mechanism for interfacing with hardware
- Goals of API:
  - abstraction
  - standardization
  - interoperability



Operating Systems APIs

OS Level API such as Linux API and Win32 with kernel provides API to programs to access system resources such as file system, device driver, network, etc

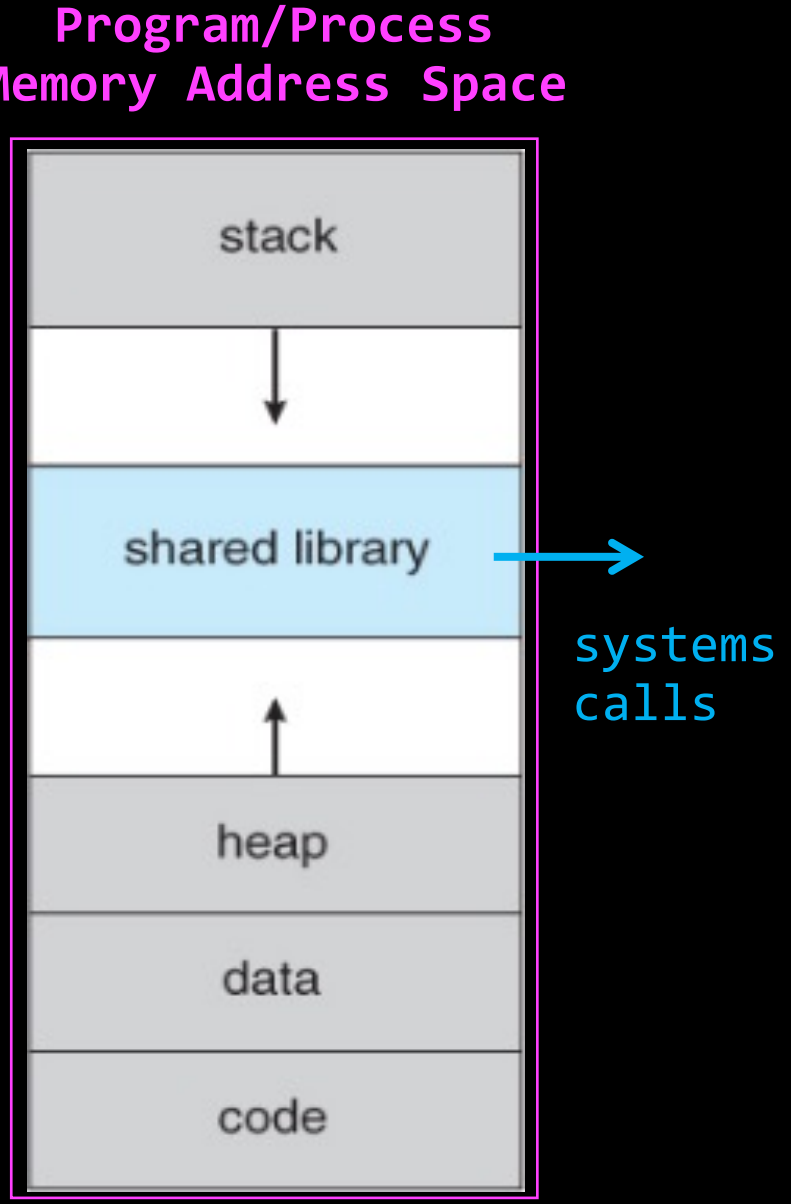



```c
#include <stdio.h>
#include <unistd.h>
#include <stdlib.h>

int main() {
 pid_t child_pid = fork();

 if (child_pid > 0) {
   printf("Child process ID: %d\n", child_pid);
   wait(NULL);
   printf("Child process finished\n");
   exit(EXIT_SUCCESS);
 }
 else {
   exit(EXIT_FAILURE);
 }
}
```

Libraries are not APIs

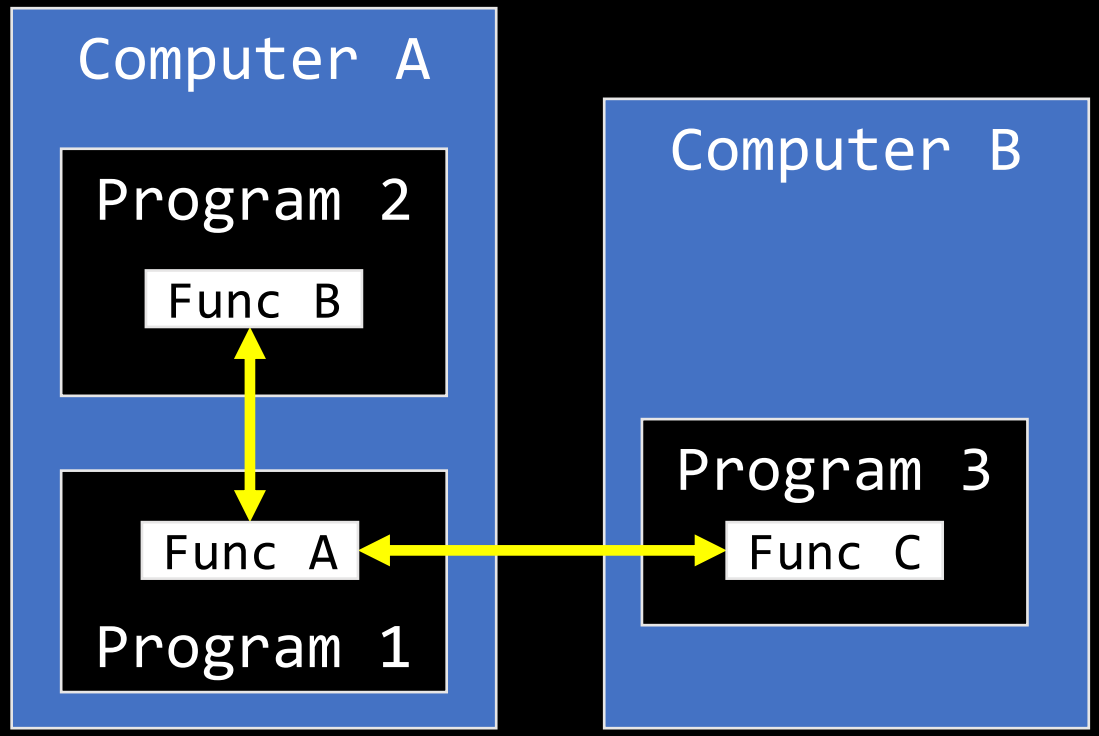
- In Windows DLL (Dynamic Linked Libraries) are compiled code that can be loaded into the the user program memory address space to access OS API.
- The equivalent in Linux is shared libraries e.g.libc, libssl

Link libraries are not considered APIs because they operate in the memory space of the program and it is the system calls that provides the interface to the underlying OS services



Remote Procedure Calls

Remote Procedure Calls (RPCs) are a mechanism that allows a computer program to execute code in a different memory address space, which may be on a remote machine. The basic idea behind RPCs is that a program can call a function or procedure in a different address space just as if it were a local function call.



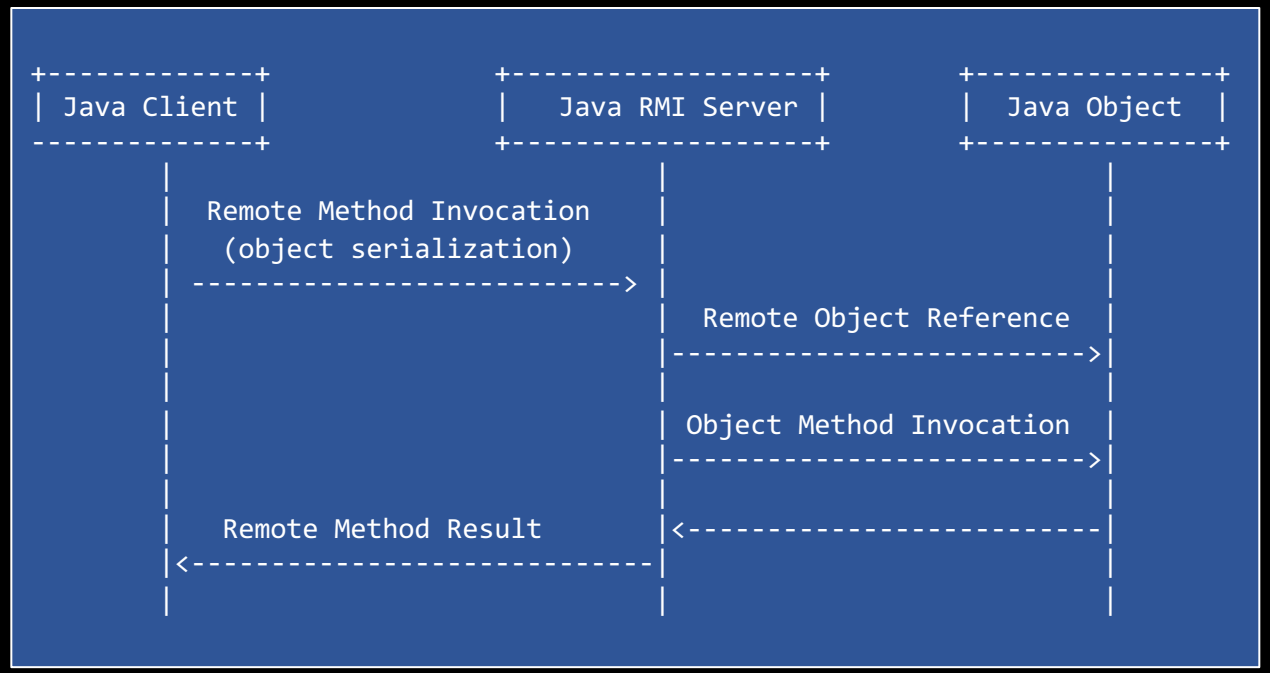
program == process

- Form of inter-process communication
- Can be used over different network protocols such as TCP, UDP, and HTTP
- Requires the data to be serialized and deserialized for transfer over the network
- Involves IDL (Interface Definition Language) for cross-platform integration. IDL define the methods, arguments, and return types of the remote procedure calls
- Examples for RPC: Java RMI, CORBA, Thrift, Avro, protobuf

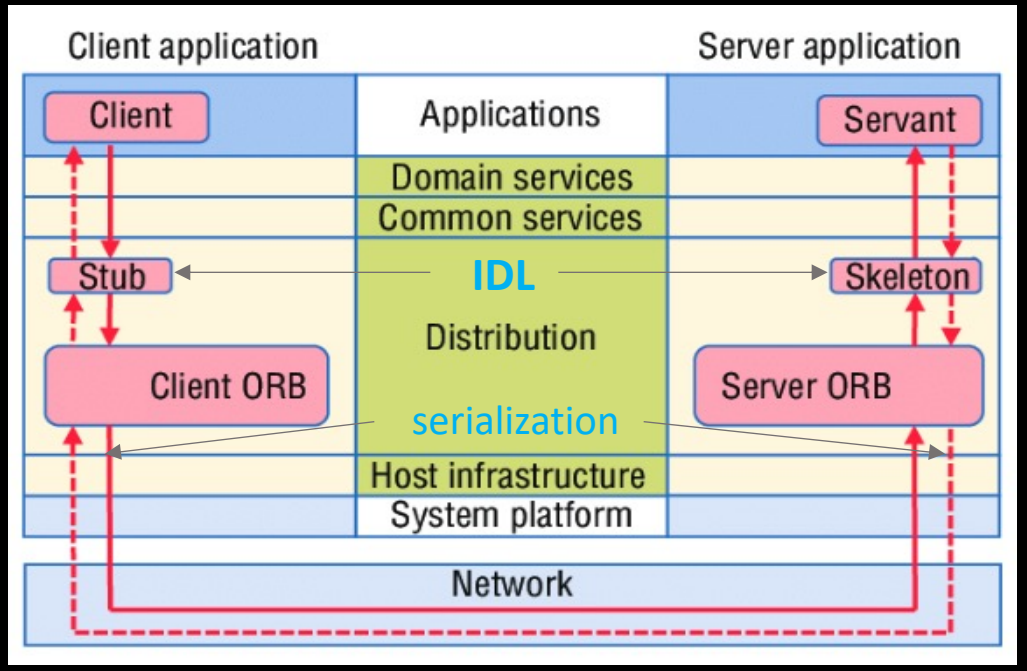
RPC Beware

- Requires client to implement complex error handling mechanisms
- Highly susceptible to the availability of a network and the remote service
- Performance is highly dependent on the network latency between client and server
- Compatibility issues with programming language and IDLs

JAVA RMI



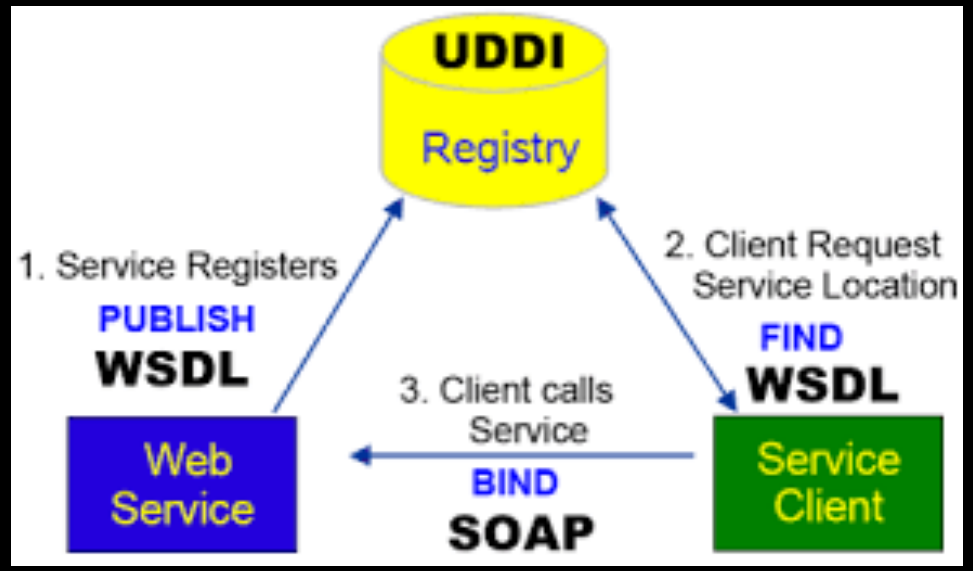
CORBA



RISE of the Web APIs

First Came SOAP Web Services

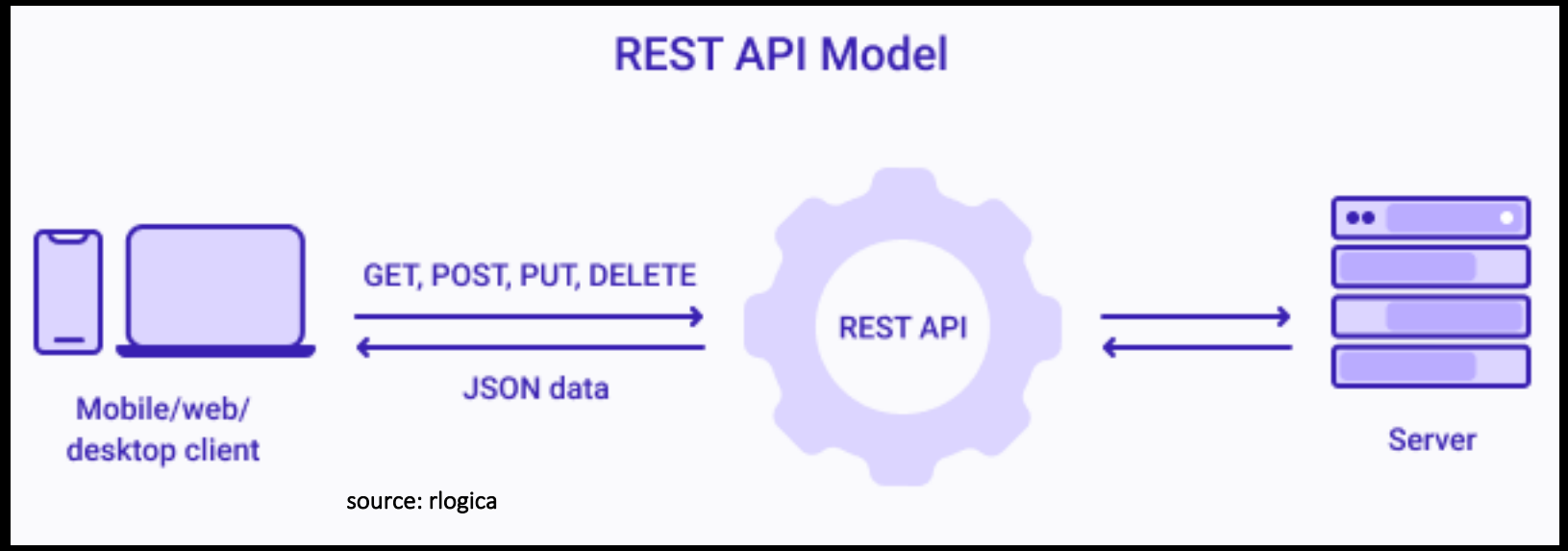
- Good: over standard HTTP protocol
- Bad: dependant on XML which adds overhead including transformation & parsing.
- Bad: WSDL like IDL, laborious to maintain
- Ugly: UDDI global registry of web service concept failed to take-up




```
<?xml version="1.0" encoding="UTF-8"?>
<definitions name="Bookstore"
  targetNamespace="http://example.com/bookstore"
  xmlns="http://schemas.xmlsoap.org/wsdl/"
  xmlns:soap="http://schemas.xmlsoap.org/wsdl/soap/"
  xmlns:tns="http://example.com/bookstore"
  xmlns:xsd="http://www.w3.org/2001/XMLSchema">

  <types>
    <xsd:schema
targetNamespace="http://example.com/bookstore">
      <xsd:element name="bookId" type="xsd:int"/>
      <xsd:element name="title" type="xsd:string"/>
      <xsd:element name="author" type="xsd:string"/>
      <xsd:element name="price" type="xsd:float"/>
    </xsd:schema>
  </types>

  <message name="getBookRequest">
    <part name="bookId" element="tns:bookId"/>
  </message>

  <message name="getBookResponse">
    <part name="title" element="tns:title"/>
    <part name="author" element="tns:author"/>
    <part name="price" element="tns:price"/>
  </message>

  <portType name="BookstorePortType">
…
```

The Came RESTFul API

- Uses a simple and platform independent set of HTTP methods interact with resources identified by URIs
- Lightweight: use of JSON and scaled to handle large amounts of traffic.
- Stateless: simplifies server-side development and allows for better scalability and fault tolerance



The term "REST" stands for "Representational State Transfer", which was coined by Roy Fielding in his doctoral dissertation in 2000

"Representational State Transfer" reflects the idea that a client can access and manipulate the representation of a resource (i.e., its state) through a standardized set of operations (i.e., transfer).

REST Example: Pet store

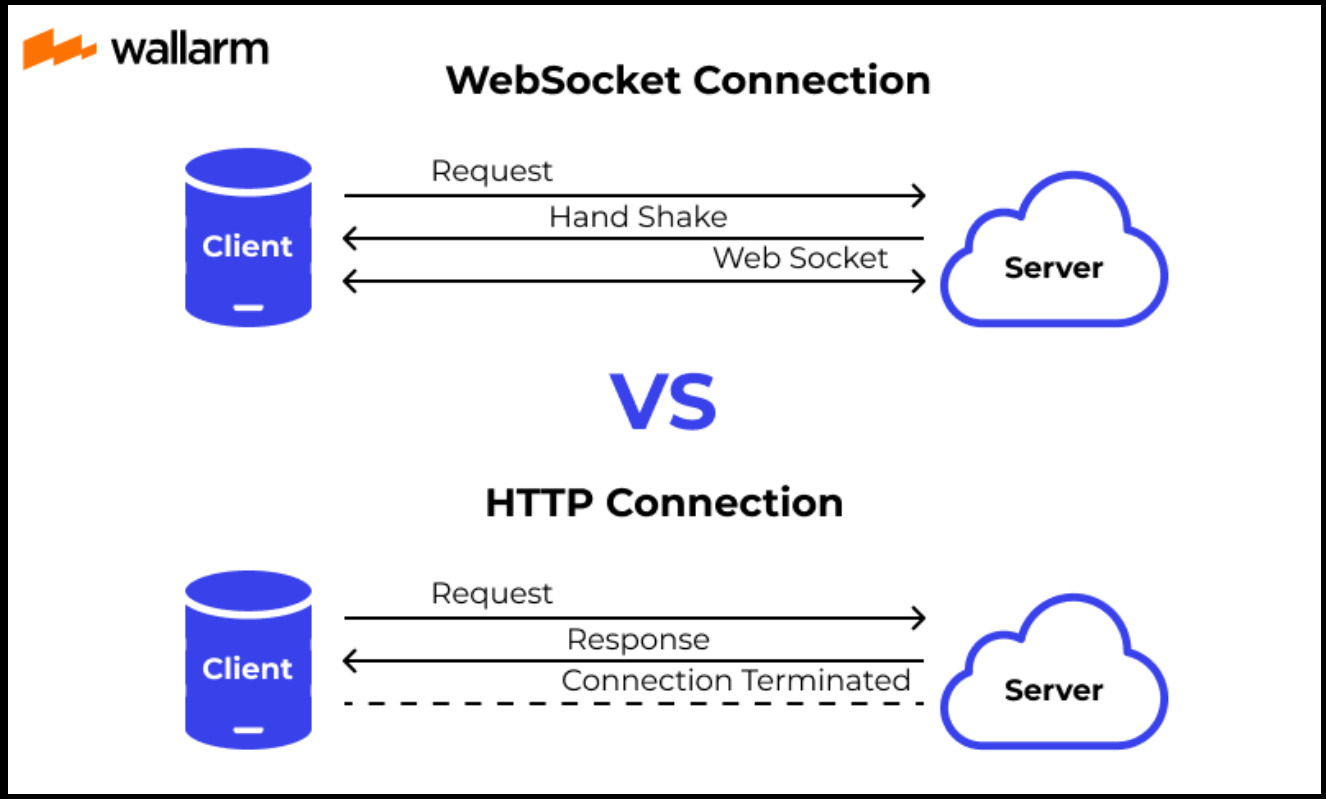

```
curl -X 'GET’
'https://petstore.swagger.io/v2/pet/findByStatus?status=
available’ \
-H 'accept: application/json'
```

```
curl -X 'POST' 'https://petstore.swagger.io/v2/pet’ \
-H 'accept: application/json’ \
-H 'Content-Type: application/json’ \
-d ‘{
 "id": 0,
 "category": { "id": 0, "name": "string" },
 "name": "doggie",
 "status": "available"
}'
```

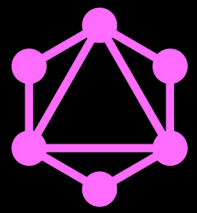
https://petstore3.swagger.io

Going 2-way: Web Socket

- Enable two-way communication between a client and a server over a single, long-lived connection.
- For real-time applications
- Allow binary data transfer
- Supported in most modern web browsers using the WebSocket API, which is part of the HTML5 specification.



>> Do not be confused with **web hook** which a one-way server-to-client typically for notifications



GraphQL

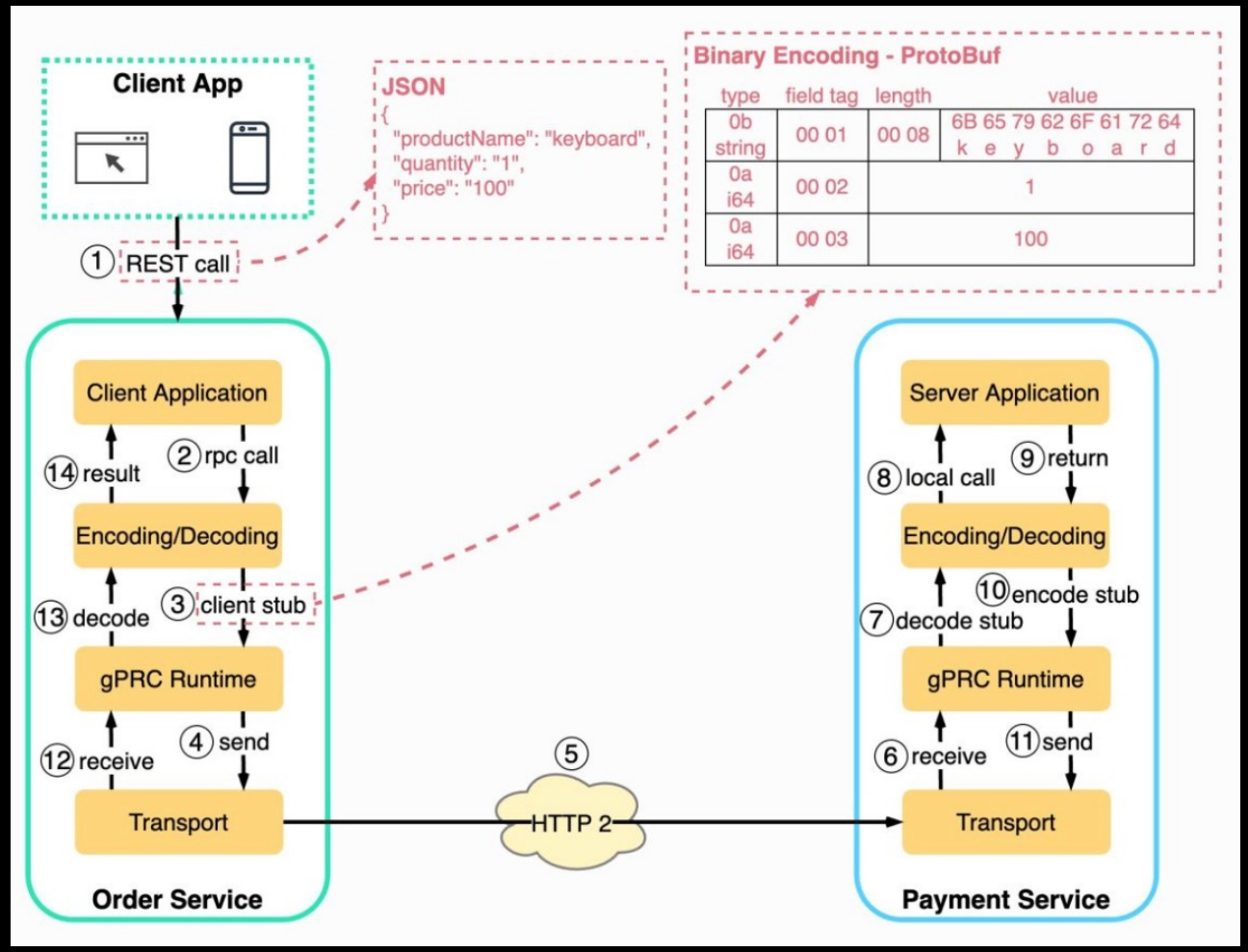
- GraphQL is an open-source query language and runtime for APIs developed by Facebook.
- Defines a schema that provides a strongly-typed interface for client
- Unless REST, allow clients to specify exactly what data they need
- Aggregate multiple resource requests in a single query
- Subscriptions: for client to receive notifications for data modifications
- Mutations: apply data modifications to resources

```
query {
 pets(species: "Cat", age_lt: 3) {
  id
  name
  age
  breed
 }
}
```

gRPC

RPC is dead, Long Live gRPC

- gRPC is a high-performance, open-source framework originally developed by Google.
- Communicate over HTTP/2 or TCP, using a binary serialization format called Protocol Buffers.
- More commonly used for communication between micro-services
- Some adoption on mobile client



Working with REST APIs

API Design Principles

Resilient	Stateless distributed computing and incorporate error handling, time-outs and monitoring.
Abstraction	Course grain API that provides functionality with abstraction away implementation details
Maintainable	Version control, flexible to change, keep things simple, intuitive and well-documented.
Performant	Loose-coupling and asynchronous communication to improve the responsiveness and scalability of the API. Use caching to reduce network round-trips.
Secured	Encrypted communication, authentication & authorisation, data validation, security best practices.

Use JSON

JSON stands for JavaScript Object Notation. It is a lightweight data interchange format that is easy for humans to read and write, and easy for machines to parse and generate. it is language-independent.

Useful Links:

https://quickref.me/json.html

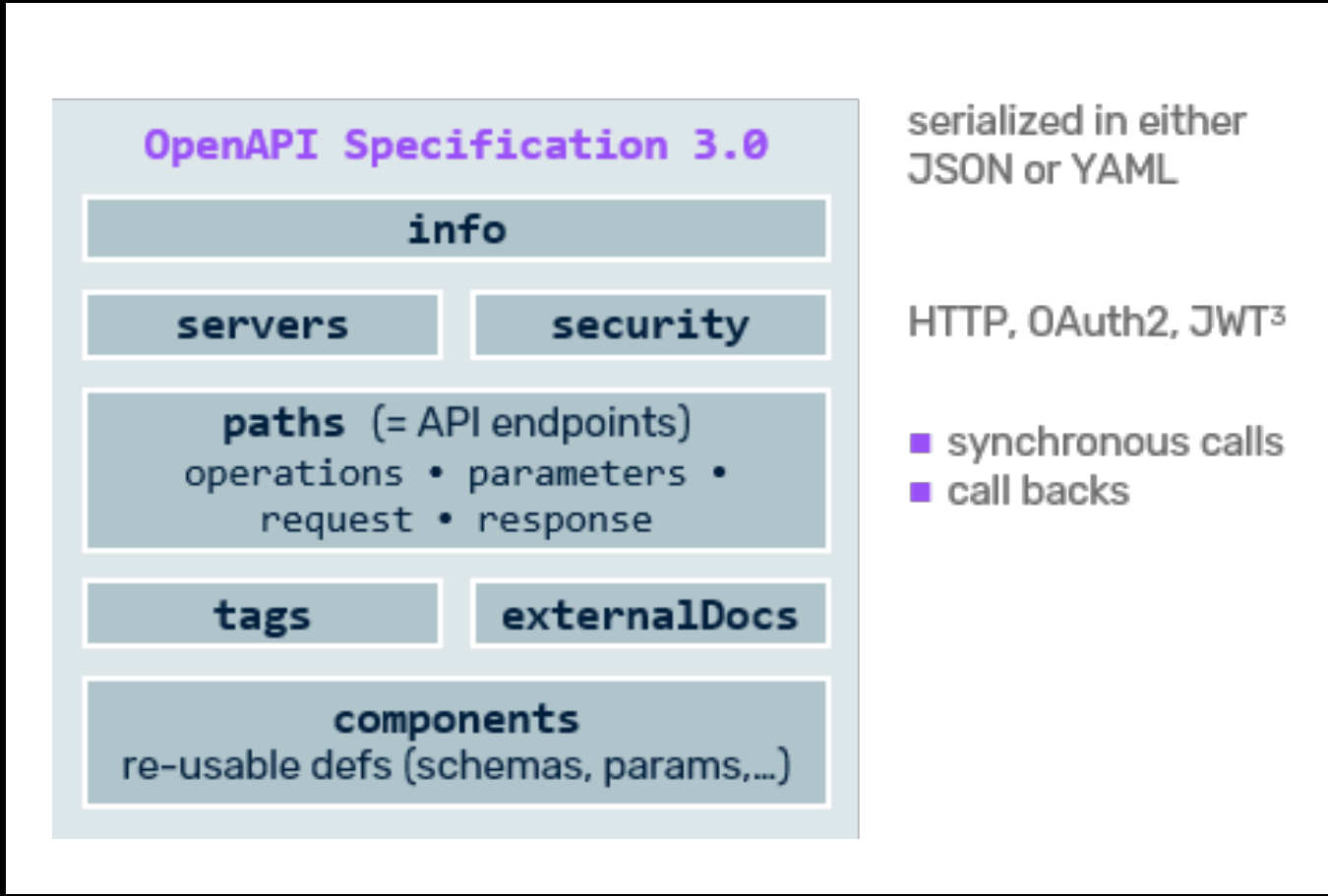
https://jsoneditoronline.org

https://codebeautify.org/jsonviewer

```
{
  "employees": [
    {
      "Name": "John Doe",
      "Active": true,
      "age": 30,
      "jobTitle": "Software Engineer"
    },
    {
      "Name": "Jane Smith",
      "Active": true,
      "age": 25,
      "jobTitle": "Web Developer"
    },
    {
      "Name": "Bob Johnson",
      "Active": true,
      "age": 40,
      "jobTitle": "Project Manager"
    }
  ]
}
```

Specify with OpenAPI/Swagger

- Open-source specification for building, documenting, and consuming RESTful APIs.
- Host API on SwaggerHub
- Online Editor
- Download APIs, Documentations and SDKs
- VSCode Extension from 42crunch for API Security



Know curl://

curl is a command-line tool used to transfer data to or from a server using various protocols, including HTTP, FTP, SMTP, POP3, and many others.

hide progress	verbose	extra info	output	timeout
-s	**-v** **--trace-ascii <file>**	**-w "format"**	**-O** **-o <file>**	**-m <seconds>**
POST	POST encoded	multipart formpost	PUT	HEAD (ers too)
-d "string" **-d @file**	**--data-urlencode "[name]=val"**	**-F name=value** **-F name=@file**	**-T <file>**	**-I** **-i**
custom method	read cookiejar	write cookiejar	send cookies	user-agent
-X "METHOD"	**-b <file>**	**-c <file>**	**-b "c=1; d=2"**	**-A "string"**
proxy	add/remove headers	custom address	smaller data	insecure HTTPS
-x <host:port>	**-H "name: value"** **-H "name:"**	**--resolve <host:port:addr>**	**--compressed**	**-k**
Basic auth	follow redirects	parallel	generate code	list options
-u user:passwd	**-L**	**-Z**	**--libcurl <file>**	**--help**

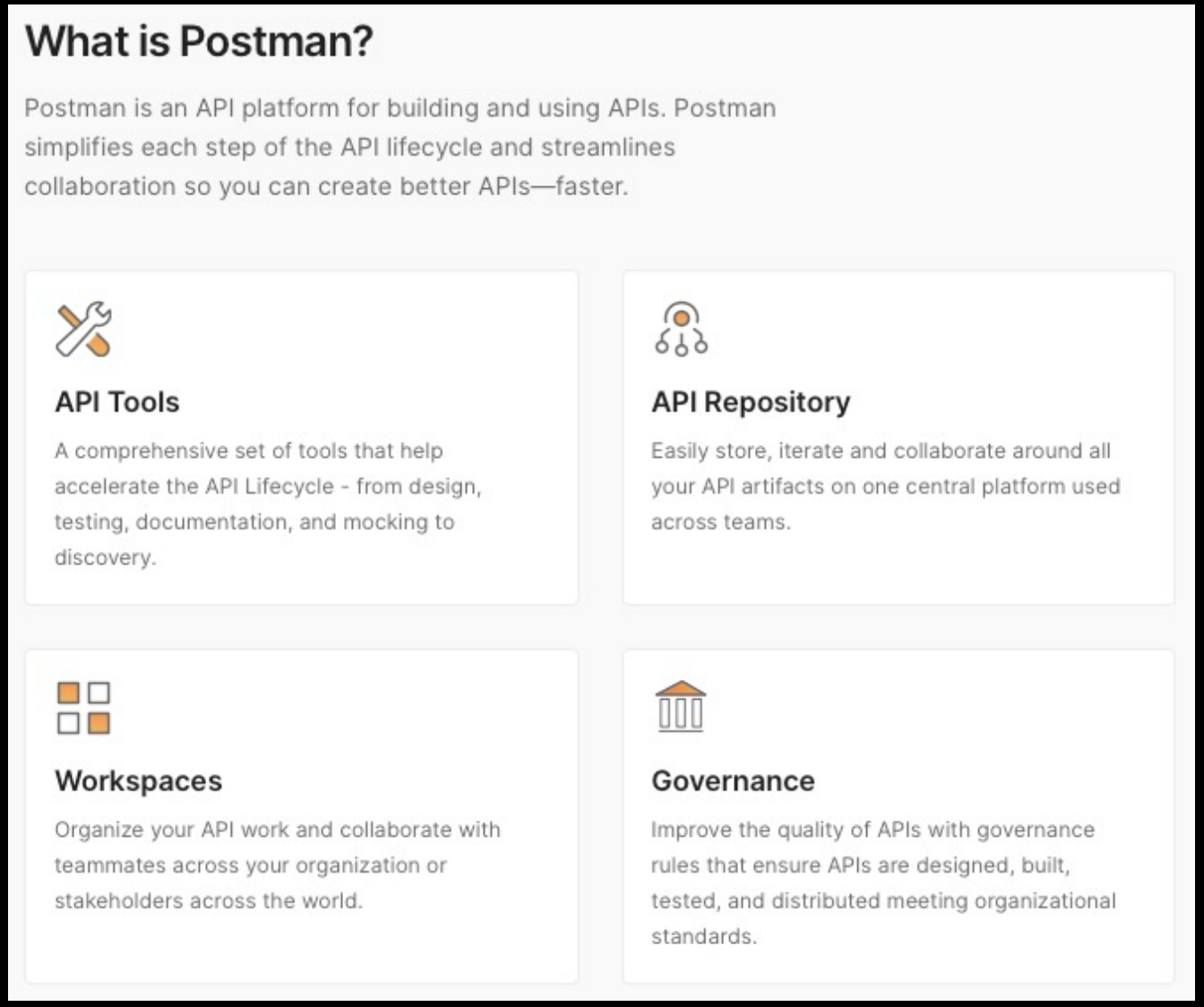
https://quickref.me/curl

Powershell (pwsh)

```
PS C:\> Invoke-WebRequest
```

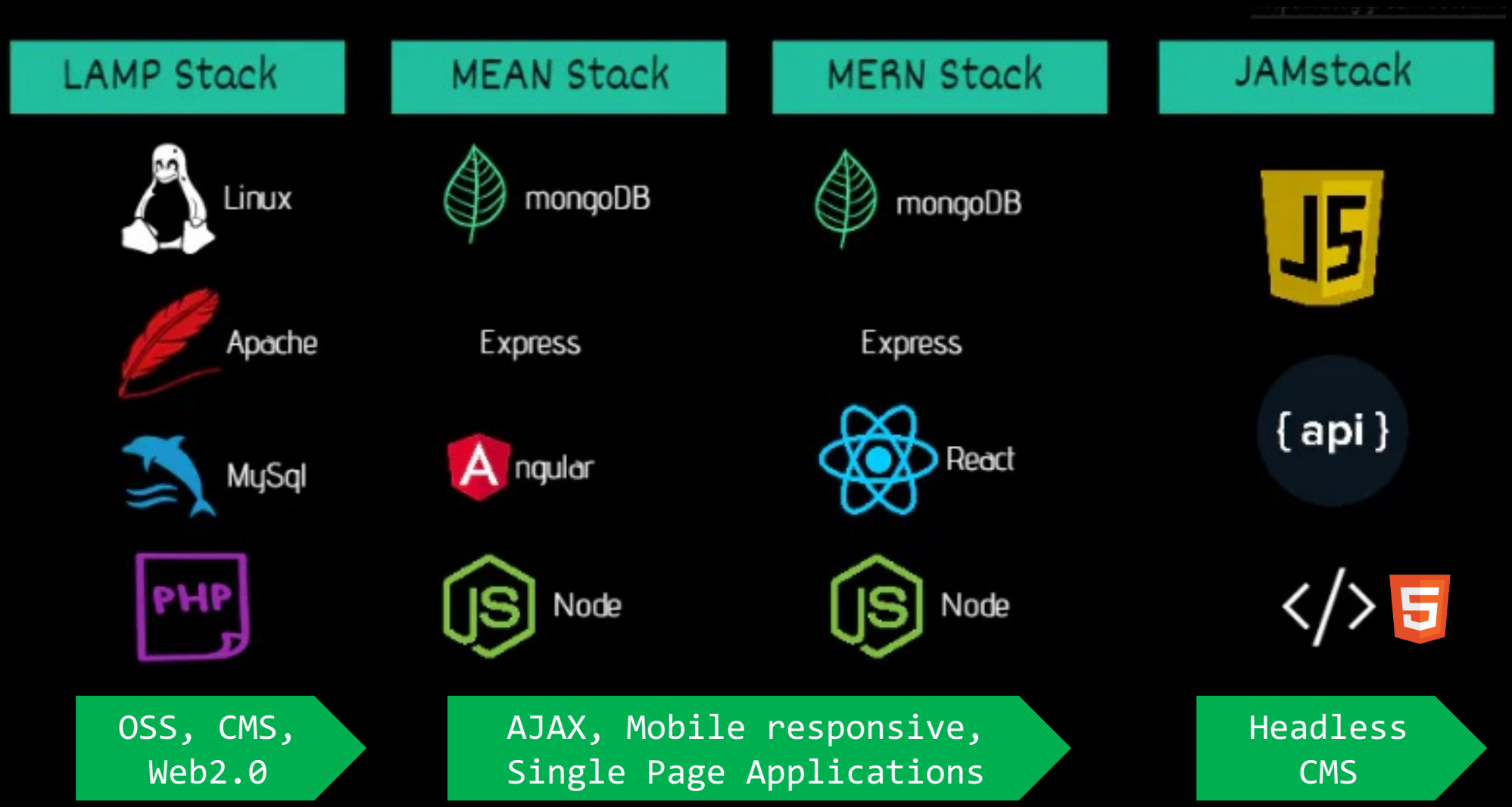
Postman

- www.postman.com
- Great tool for testing APIs
- Sign-up for free
- Download Clients




API Rules the World

The War of Stacks



https://blog.greenroots.info/jamstack-for-all-an-introduction

NodeJS & Express

- NodeJS is an open-source, cross-platform server based on JavaScript runtime. It uses an event-driven, non-blocking I/O model that allows it to handle multiple requests simultaneously with minimal resources.
- Express is Web Framework that runs on Node.

Get Started

1. Download and install Node
2. Ask ChatGPT to create an express API server that has 1 get method for retrieving pet by id and and 1 post method to add new pet
3. Create project
4. Install NPM packages
5. Cut and paste code
6. Start Server

FastAPI

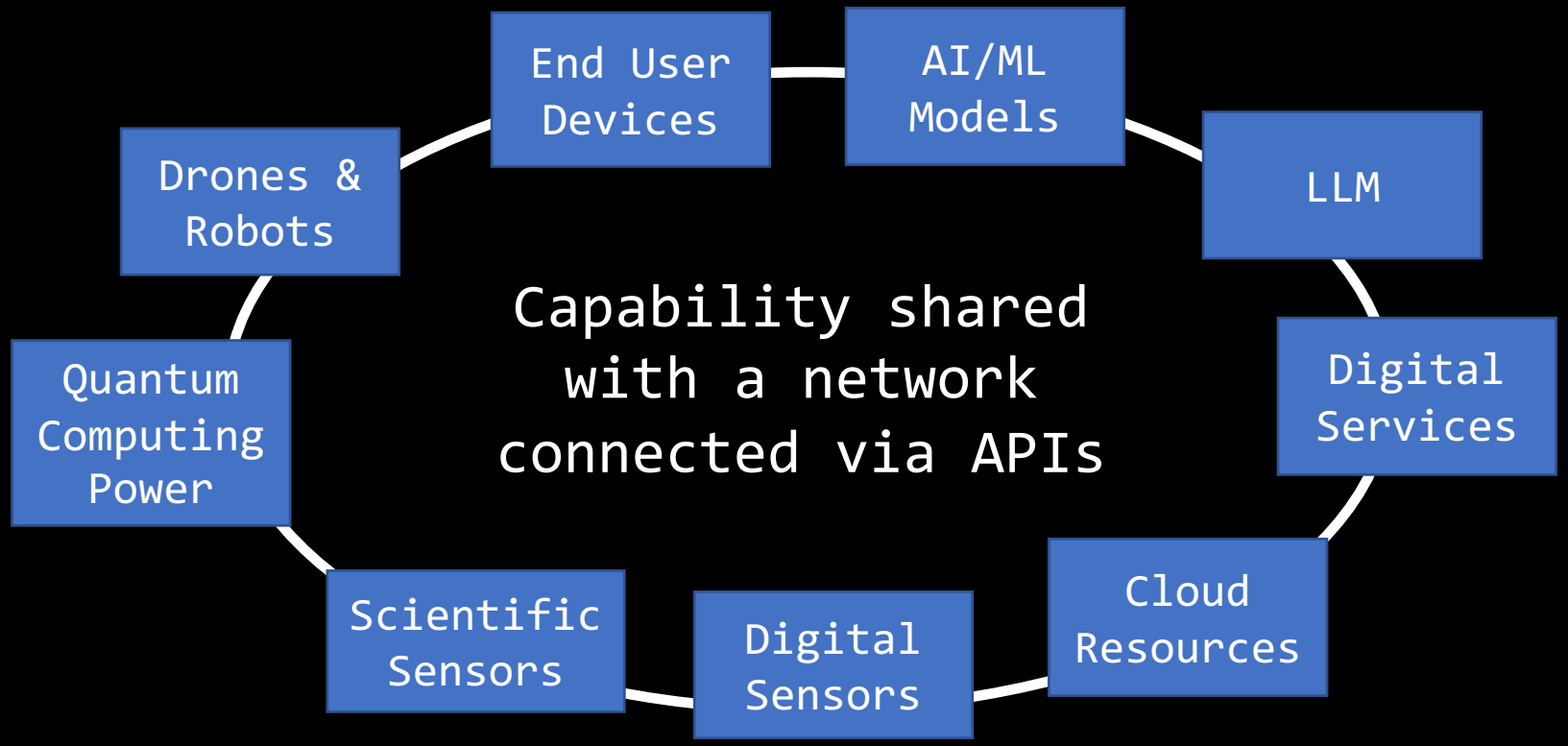
FastAPI is a modern, fast (hence the name), web framework for building APIs with Python. It is designed to be easy to use, high-performance, and to provide automatic validation of request date & automatically generate OpenAPI documentation

Get Started

1. Create a project folder with virtual environment
2. Ask ChatGPT to write an api server using fast API for a book store with 5 books preloaded
3. Run the code on uvicorn
4. Check out the docs
5. Call OpenAI API

In the End: United by AI

- APIs provides abstractions to allow different technologies to be integrated, consuming services to create multiplying effect
- Shift thinking to – “How can others consume my service?”



Thank You

https://github.com/htxsg/citizendeveloper/tree/main/planetOfAPIs