API Protection Tools - AI Solutions Overview

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DEEPSEC

$WhoAmI

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15 years of experience as a developer
7+ years experience in application security

Agenda

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- What is API Security
- Protocols Evolution
- Common Attack Vectors
- WAF or not to WAF?
- Technical Part
- Capabilities (AI involving)
- Q&A

What Is API?

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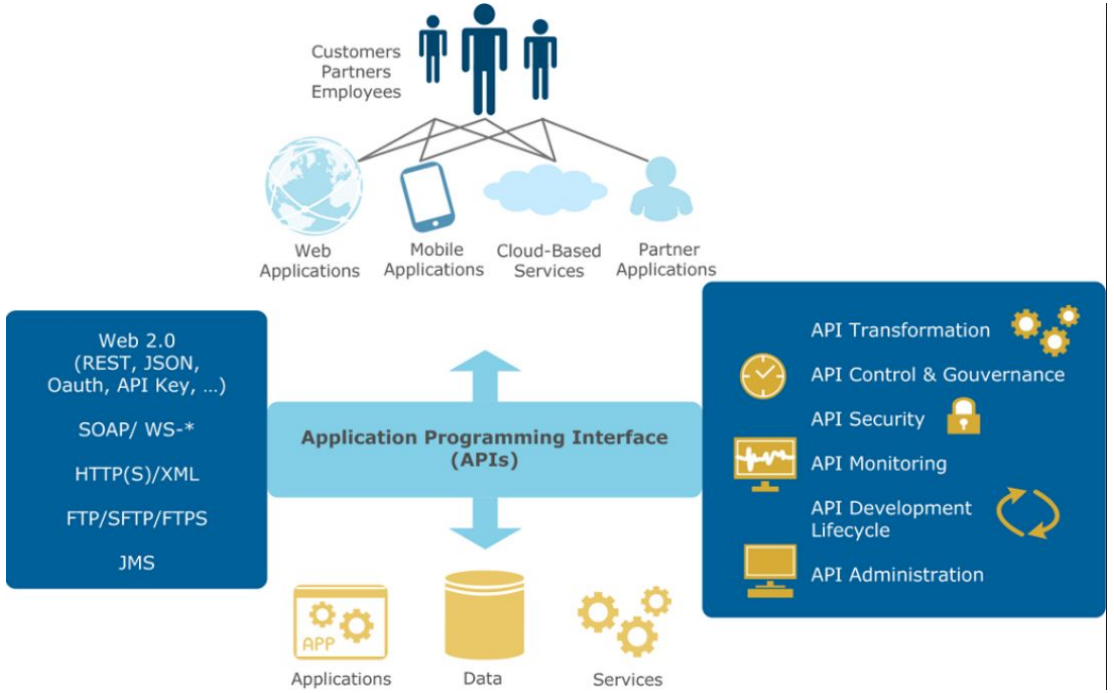
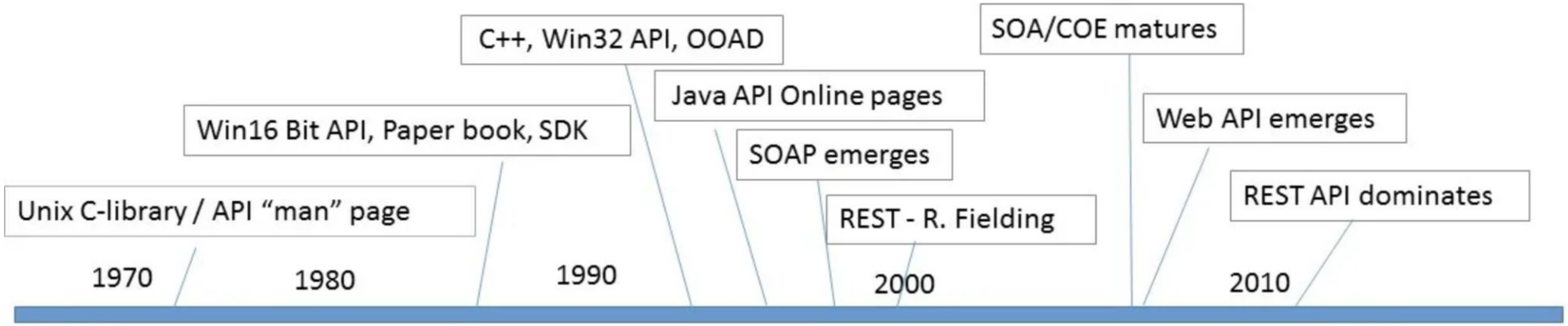
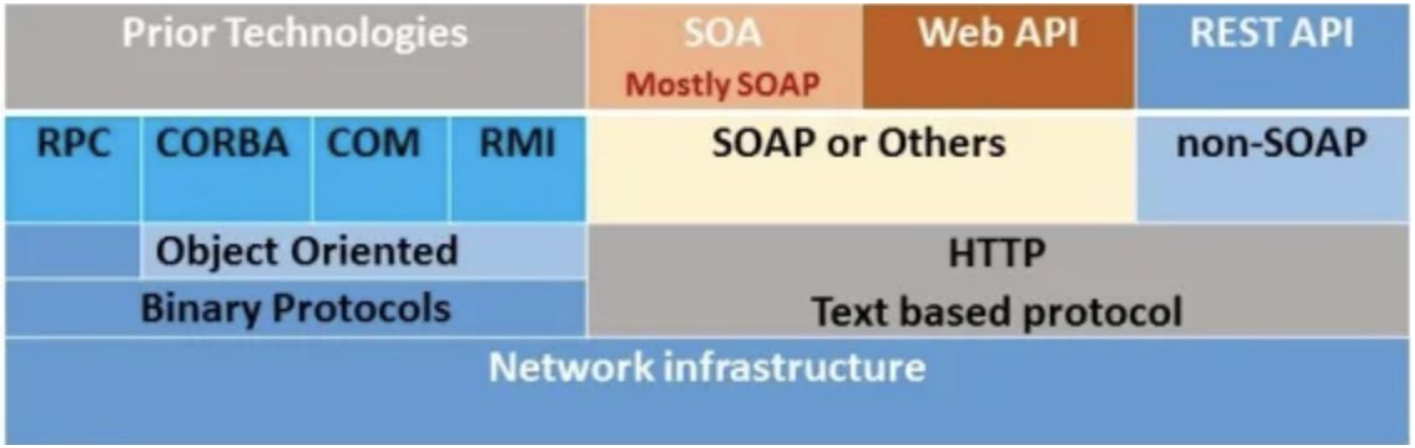
An application programming interface (API) is a set of tools, definitions, and protocols for integrating application software and services. It's the contract that lets your products and services communicate with other products and services without having to constantly build new connectivity infrastructure.



API Protocols Evolution



Rough timeline of API and SOA



API - Types

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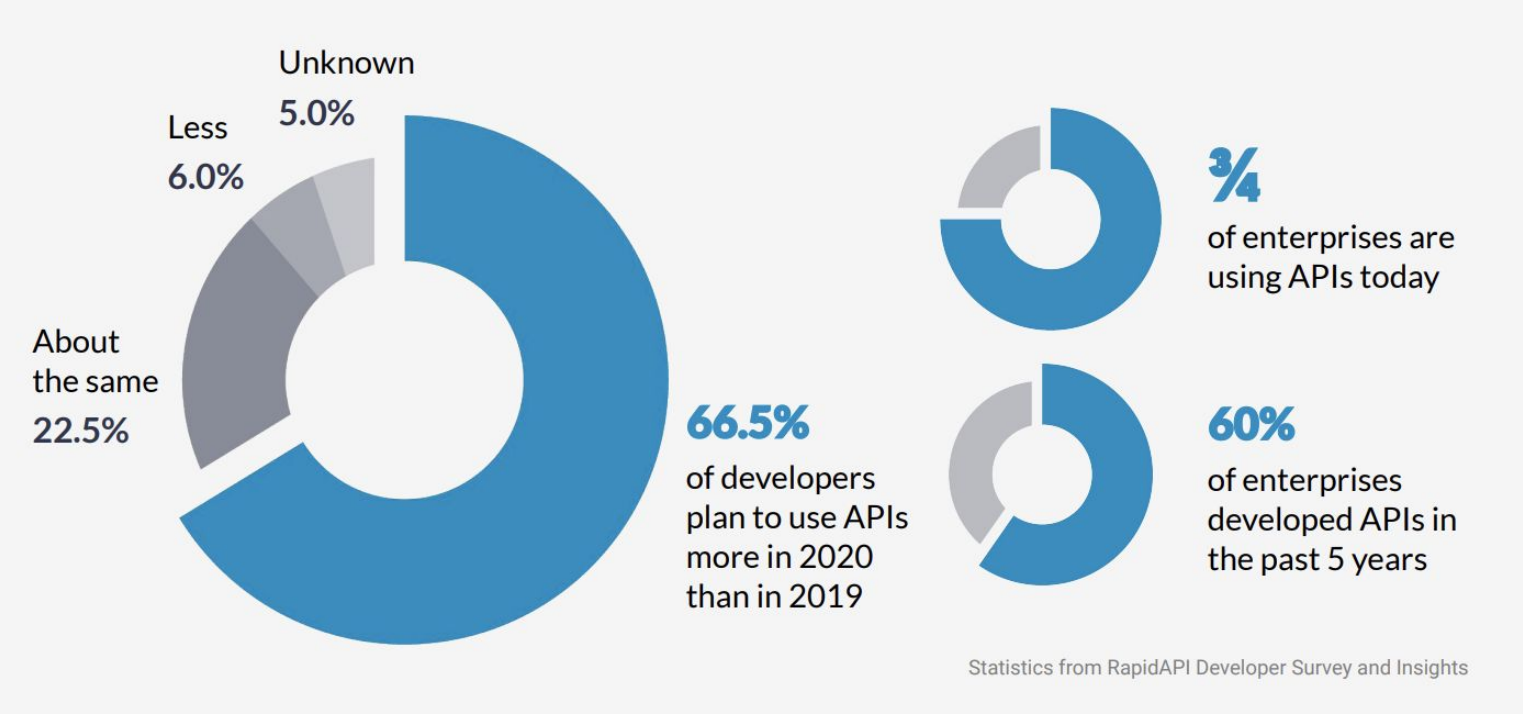
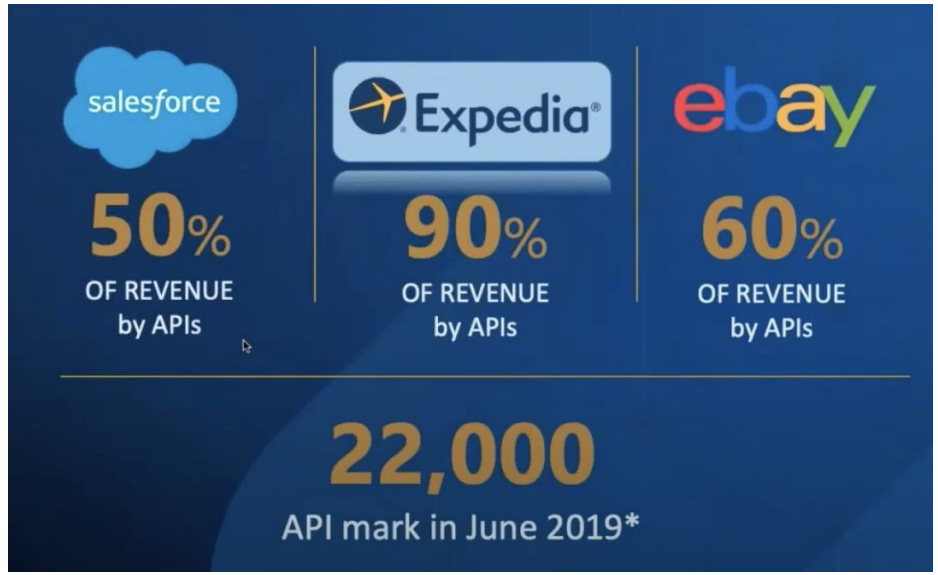
Source: L7 Defence

API - Trend


Unknown
5.0%
Less
6.0%
About
the same
22.5%
66.5%
of developers
plan to use APIs
more in 2020
than in 2019
¾
of enterprises are
using APIs today
60%
of enterprises
developed APIs in
the past 5 years
Statistics from RapidAPI Developer Survey and Insights


salesforce
50%
OF REVENUE
by APIs
Expedia
90%
OF REVENUE
by APIs
ebay
60%
OF REVENUE
by APIs
22,000
API mark in June 2019*

What Can Attackers Do With API Vulnerabilities

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T-Mobile Alerts 2.3 Million Customers of Data Breach Tied to Leaky API

Author
Tom Spring
August 24, 2018
12:42 pm
2 minute read

CSO

SALTED HASH– TOP SECURITY NEWS

NEWS

API flaws said to have left Symantec SSL certificates vulnerable to compromise

Without authentication or verification, attackers could obtain anyone's certificate simply by altering a UID

Hacking Starbucks and Accessing Nearly 100 Million Customer Records

June 20, 2020 samwcyo

Google shuts down Google+ after API bug exposed details for over 500,000 users

Search giant says it found no evidence that any user data was misused.

Salesforce Security Alert: API Error Exposed Marketing Data

Marketing Cloud Data Potentially Accessed or Corrupted Over 6-Week Period

Vulnerability Found in Venmo Public API Causing Massive Data Leak

By Nitish Singh · July 18, 2018

Lessons Learned From Hacking The Tesla API

API Attacks Are getting Sophisticated

AI based BOT is becoming the weapon of choice

API Security - Common Problems

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OWASP API Security Top 10	OWASP Top 10 (2017)
API1: Broken Object Level Authorization	A1: Injection
API2: Broken User Authentication	A2: Broken Authentication
API3: Excessive Data Exposure	A3: Sensitive Data Exposure
API4: Lack of Resources & Rate Limiting	A4: XML External Entities (XXE)
API5: Broken Function Level Authorization	A5: Broken Access Control
API6: Mass Assignment	A6: Security Misconfiguration
API7: Security Misconfiguration	A7: Cross-Site Scripting (XSS)
API8: Injection	A8: Insecure Deserialization
API9: Improper Assets Management	A9: Using Components with Known Vulnerabilities
API10: Insufficient Logging & Monitoring	A10: Insufficient Logging & Monitoring

What Can Attackers Do With API Vulnerabilities

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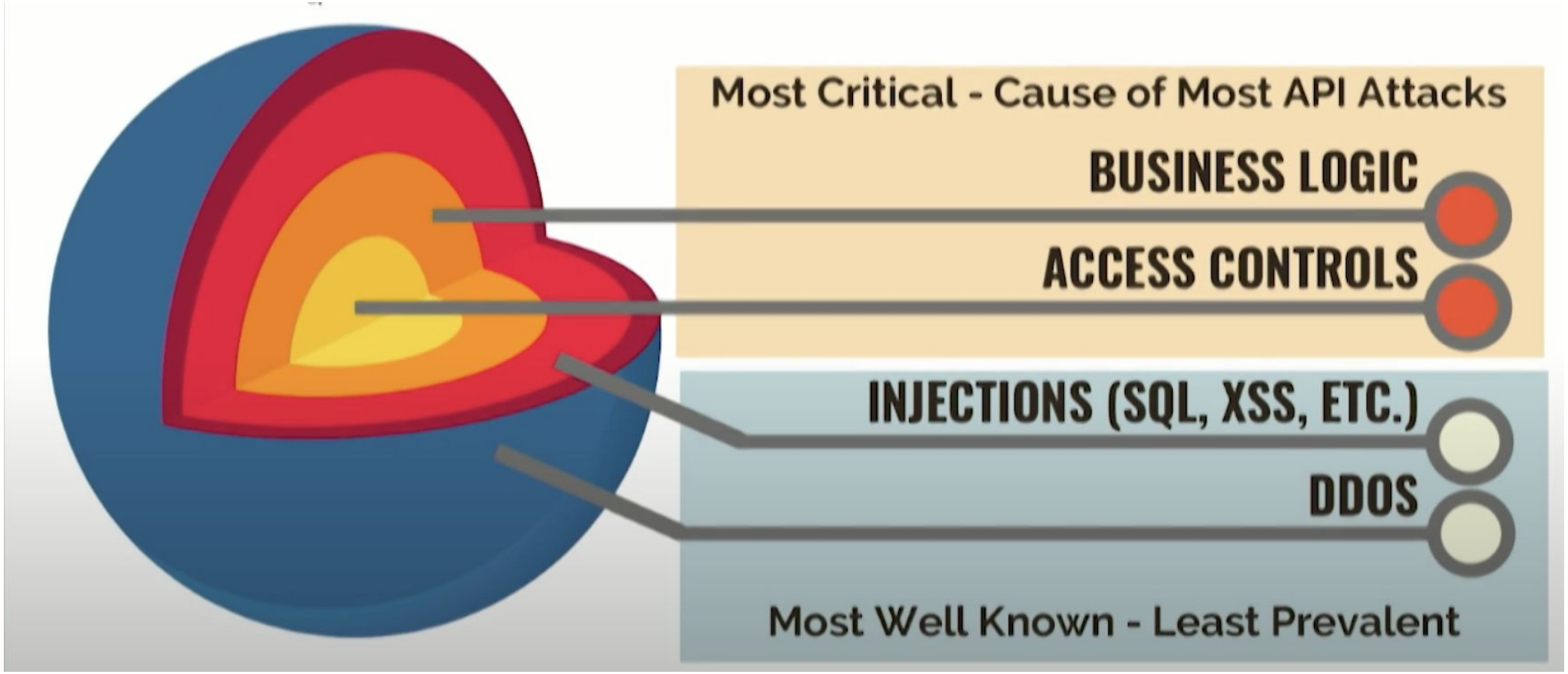

What Can Attackers Do With API Vulnerabilities

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MOST EXPLOITED API VULNERABILITIES

RBAC & ABAC VULNERABILITIES

Providing fine-grained access to resources can often lead to an explosion of RBAC roles or ABAC rules that can be easily exploited if not properly tested.

Privilege escalation vulnerabilities (RBAC) and unauthorized access to resources (ABAC) are extremely difficult to find. Such vulnerabilities have contributed to the most prominent API attacks and could cost companies extremely high fines for breaching regulatory guidelines.

BUSINESS LOGIC FLAWS

Technical security vulnerabilities (like SQL injections) come from coding errors. However, business logic vulnerabilities are due to mistakes in how the application was intended to function and APIs are the preferred point for hackers to exploit these vulnerabilities.

Since the code was correctly written, business logic vulnerabilities cannot be detected using App security tools or traditional source code analysis techniques like SAST and DAST vulnerability scanning solutions.

BOLA (Broken Object Level Authorization)

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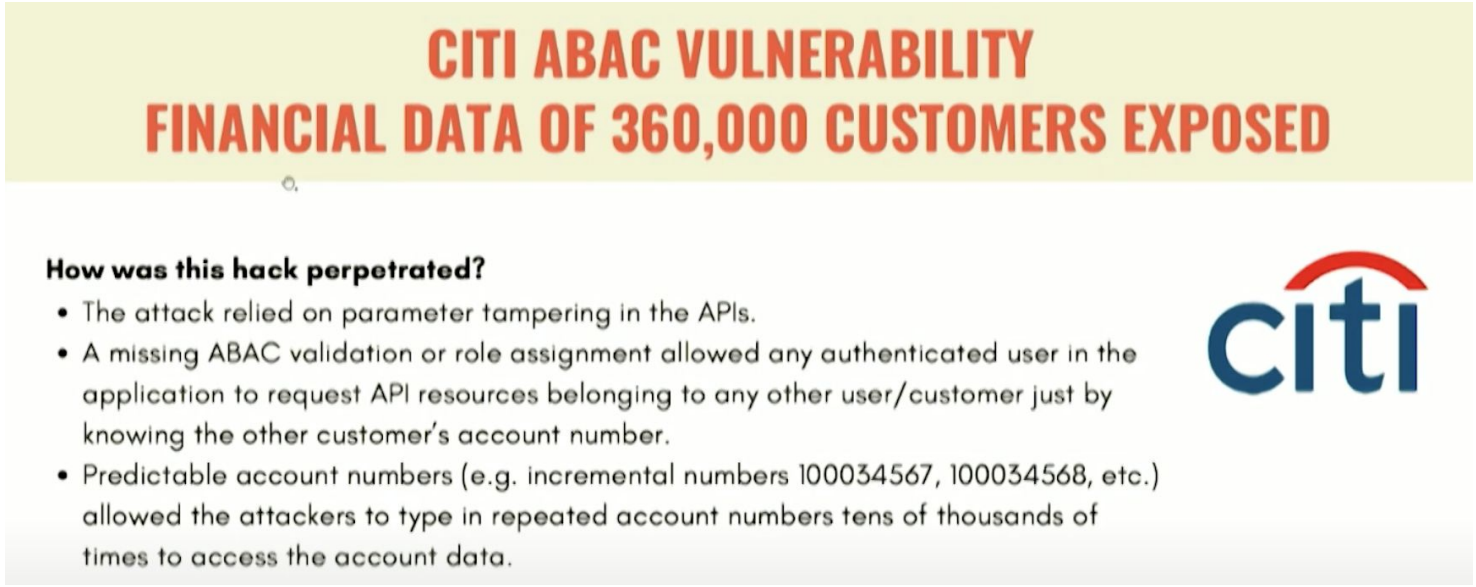
Example Attack Scenarios

Scenario #1

An e-commerce platform for online stores (shops) provides a listing page with the revenue charts for their hosted shops. Inspecting the browser requests, an attacker can identify the API endpoints used as a data source for those charts and their pattern `/shops/{shopName}/revenue_data.json`. Using another API endpoint, the attacker can get the list of all hosted shop names. With a simple script to manipulate the names in the list, replacing `{shopName}` in the URL, the attacker gains access to the sales data of thousands of e-commerce stores.

Scenario #2

While monitoring the network traffic of a wearable device, the following HTTP `PATCH` request gets the attention of an attacker due to the presence of a custom HTTP request header `X-User-Id: 54796`. Replacing the `X-User-Id` value with `54795`, the attacker receives a successful HTTP response, and is able to modify other users' account data.



Broken Function Level Authorization

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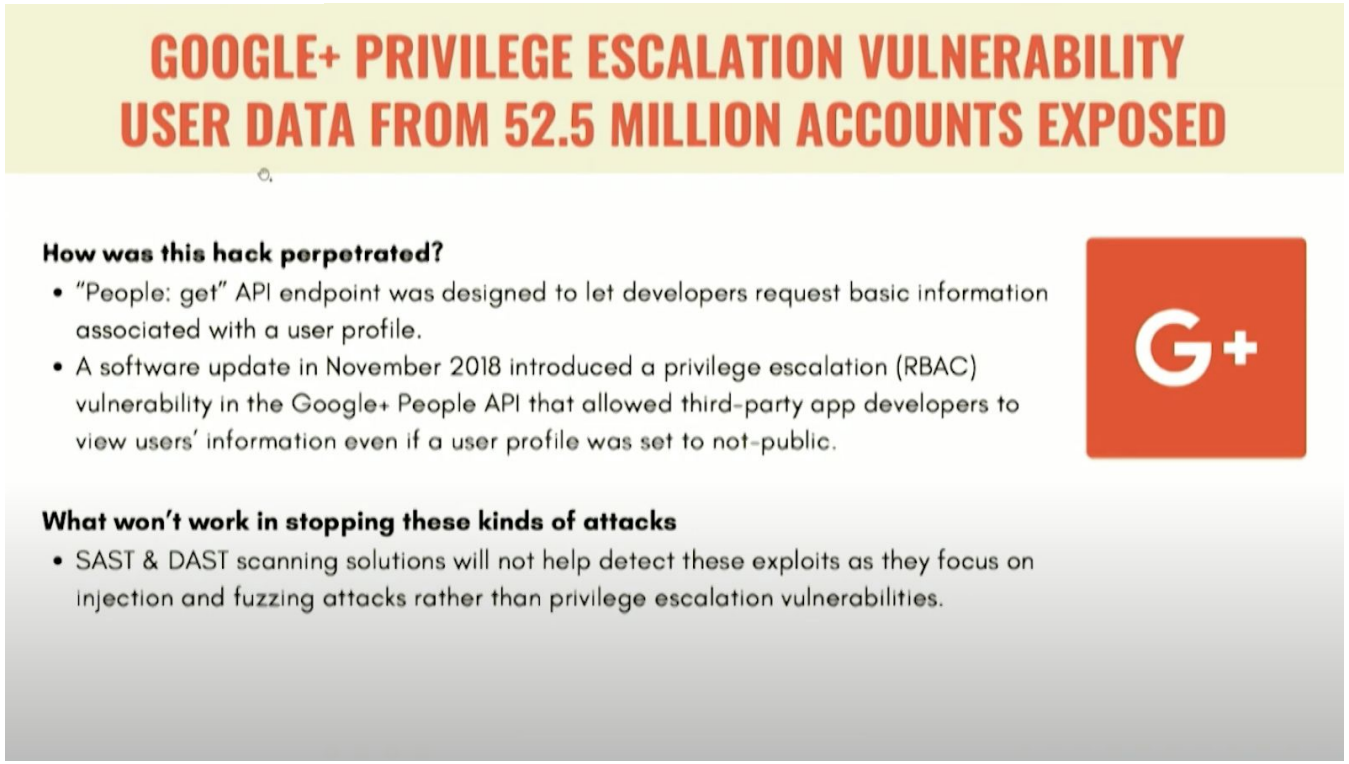
API5:2019 Broken Function Level Authorization

Scenario #2

An API contains an endpoint that should be exposed only to administrators - `GET /api/admin/v1/users/all`. This endpoint returns the details of all the users of the application and does not implement function-level authorization checks. An attacker who learned the API structure takes an educated guess and manages to access this endpoint, which exposes sensitive details of the users of the application.



What Can Attackers Do …

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- Try Resources names (admin, profile, accounts, search, pay etc …)
- Try attributes names
- Try Content-Type
- Inject/Remove data
- Use answers to find data and plan next steps

https://www.youtube.com/watch?v=qqmyAxfGV9c

New "Old" AppSec World

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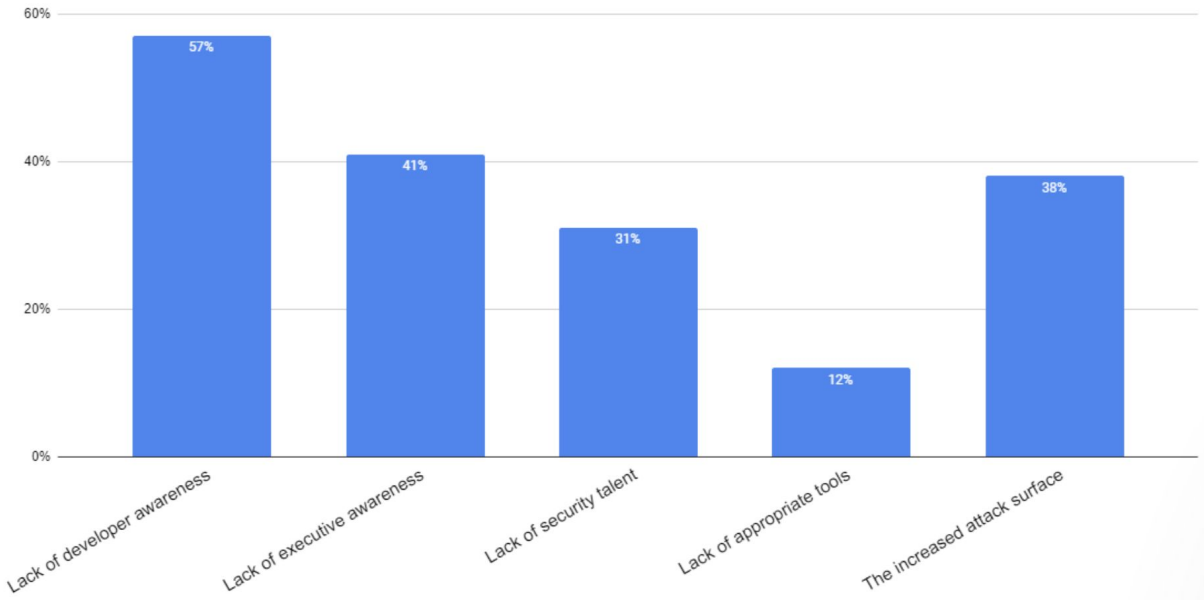
Web Application Security is painful because the security is not handled from beginning

Developers cannot define how the web application is built and designed

After 20 years of R&D, detection and protection tools have to use AI to understand how the Web Application works...



Source: 42crunch

Security Requirements

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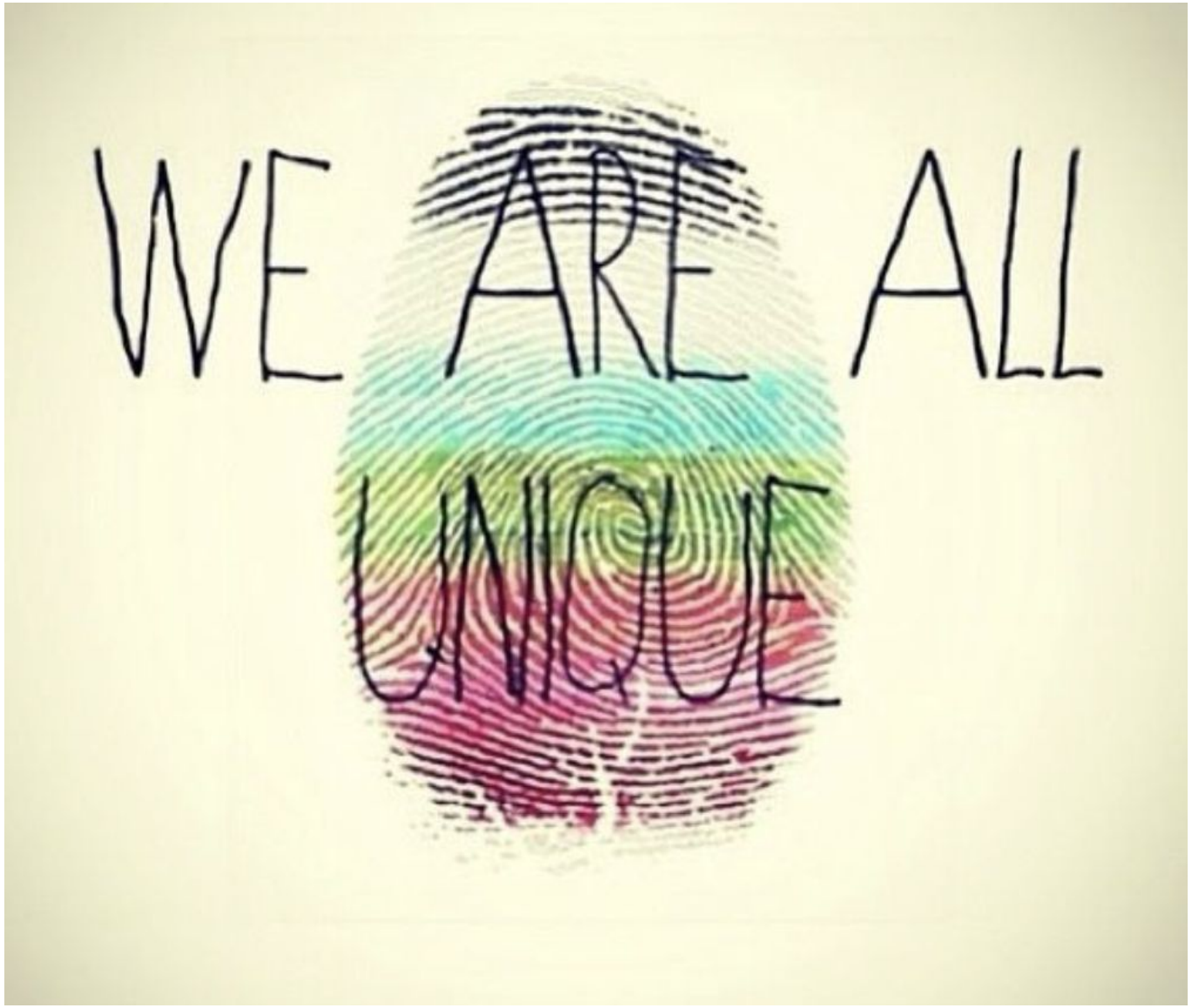
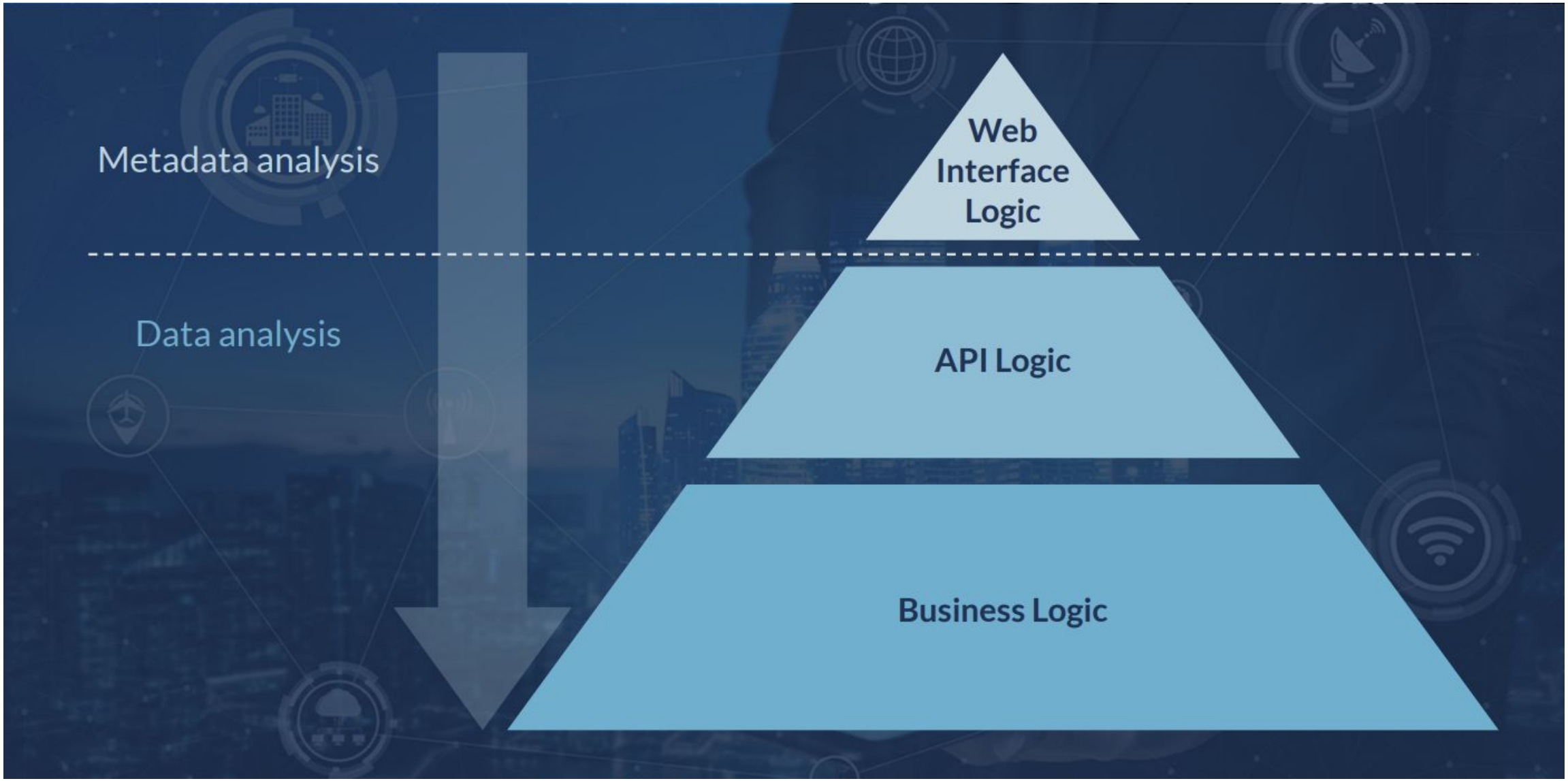

WE ARE ALL
UNIQUE


Metadata analysis
Data analysis
Web Interface Logic
API Logic
Business Logic

Security Requirements - Why AI?

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1. **High accuracy.** AI-based NLP technology automatically learns an API's business logic, going beyond metadata analysis by reviewing the actual API calls in the specific context. This approach focuses on prioritizing 'meaningful anomalies' - unusual behaviors with the potential of significantly impacting the business logic and indicating intent to manipulate the API.
2. **Prepares you for the unexpected.** While general-purpose application security solutions excel at detecting attacks that match known generic vulnerabilities, they fail when it comes to detecting zero-day, functional attacks. NLP-based security solutions learn each API's unique logic and detect any anomalous behavior that could be a functional attack.
3. **Capture different patterns in the API data.** Finding patterns in API data can be used for verifying whether any related transaction includes the required fields and alert when a transaction does not include one of these fields as an anomaly. Looking at API data as a dialogue enables users to look at the data from a sequential perspective, user clustering, and more. These are key patterns that help users understand the functional context in order to keep falses down.
   For example, NLP methods for representation learning, in which words or phrases are mapped to some array of numbers taken as input categorical data, and learn a representation for each data value.
4. **Scale your protection.** Using statistical modelling to analyze the application behavior and spot deviations from baselines can be effective on a relatively small scale. But as the amount of traffic grows, it loses efficiency and false positives grow in proportion, thereby undermining scalability. Using NLP doesn't require comprehensive and ongoing maintenance to make sure all sensitive data is recognized and protected. It allows users to maintain very high accuracy at any scale because it discards that noise and focuses on meaningful anomalies.
5. **Knowing the right context.** NLP enables security analysts to explain the meaning of specific anomalies given the objects on which they occurred, their characteristics, the relationship being manipulated, the users, and more. Essentially, this results in faster remediation and better collaboration.

Technical Solutions

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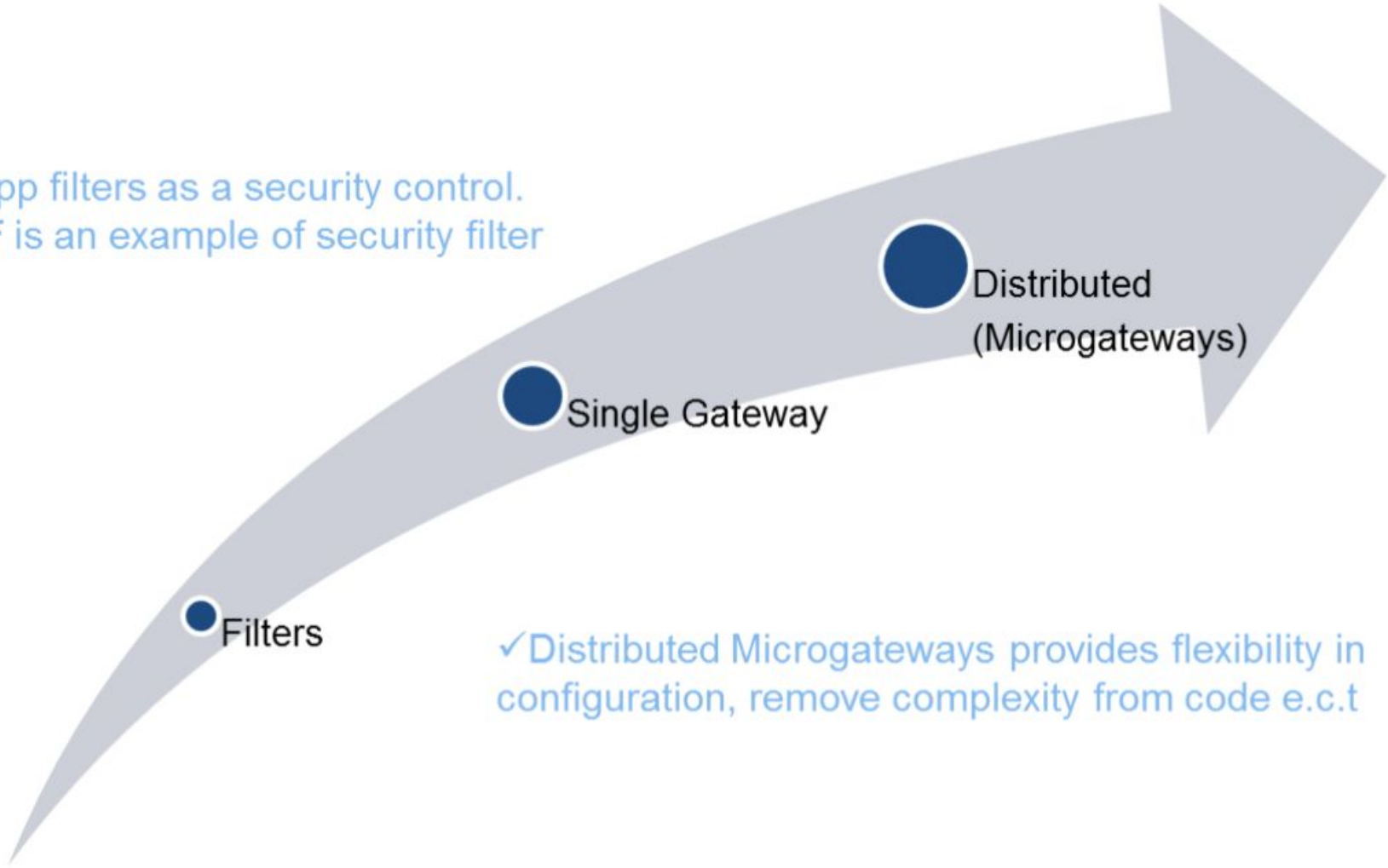
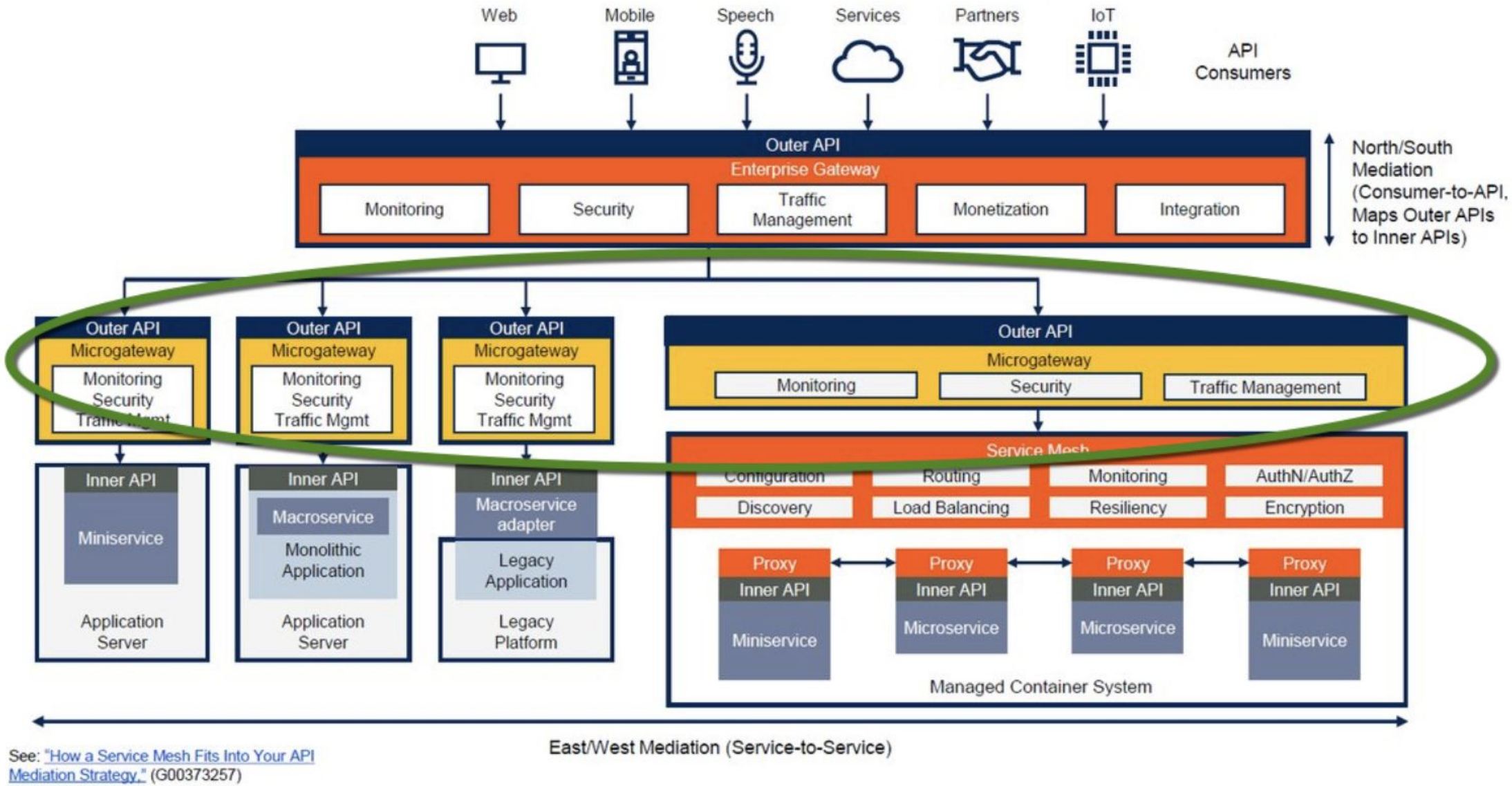
✓Started from app filters as a security control.
Embedded WAF is an example of security filter



✓Distributed Microgateways provides flexibility in configuration, remove complexity from code e.c.t

Deployments (Where to protect)



See: "How a Service Mesh Fits Into Your API Mediation Strategy," (G00373257)

What about API Gateway & WAF?

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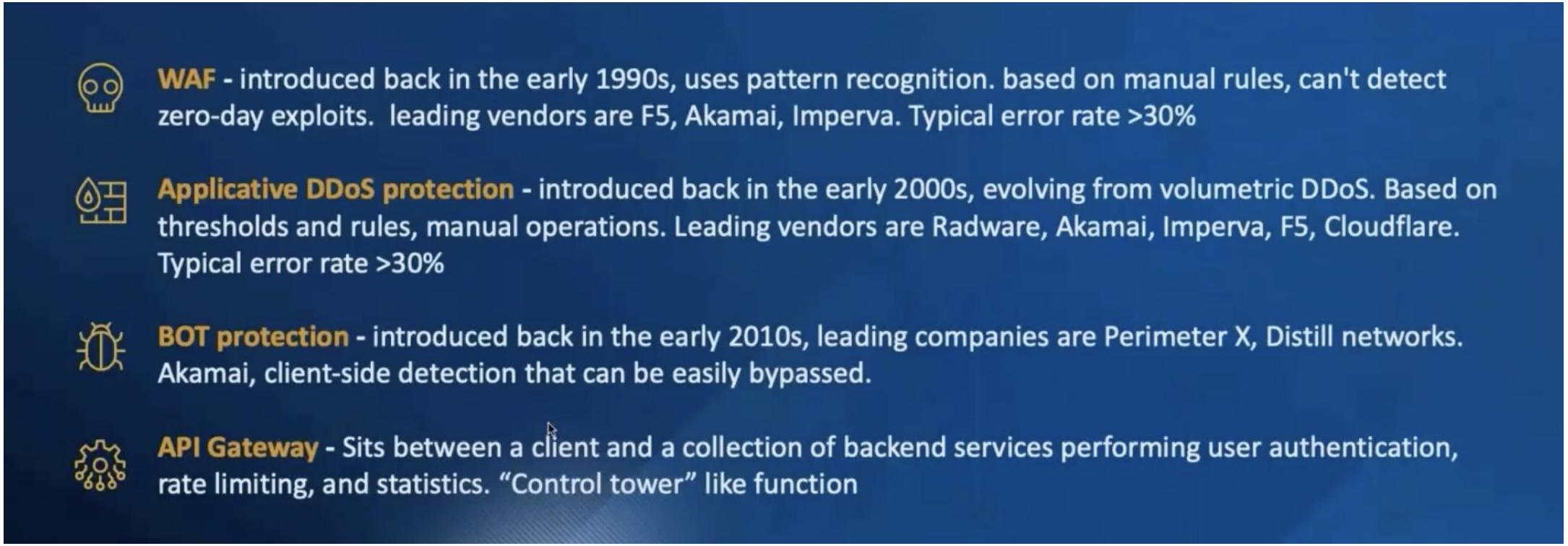
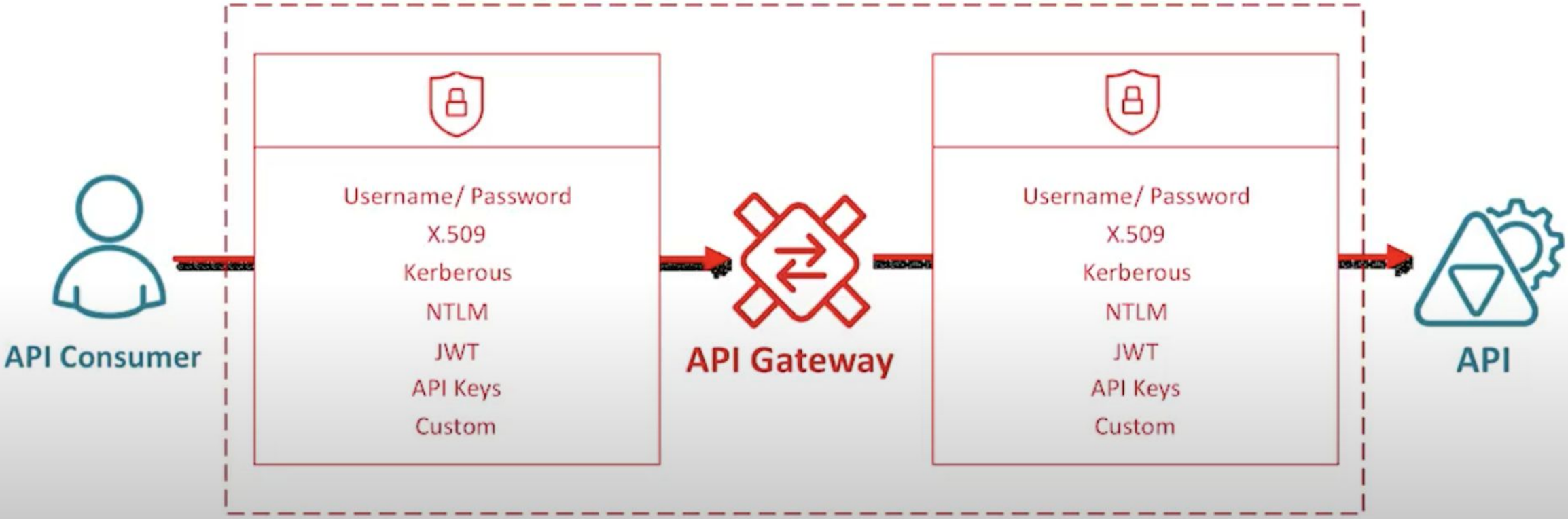


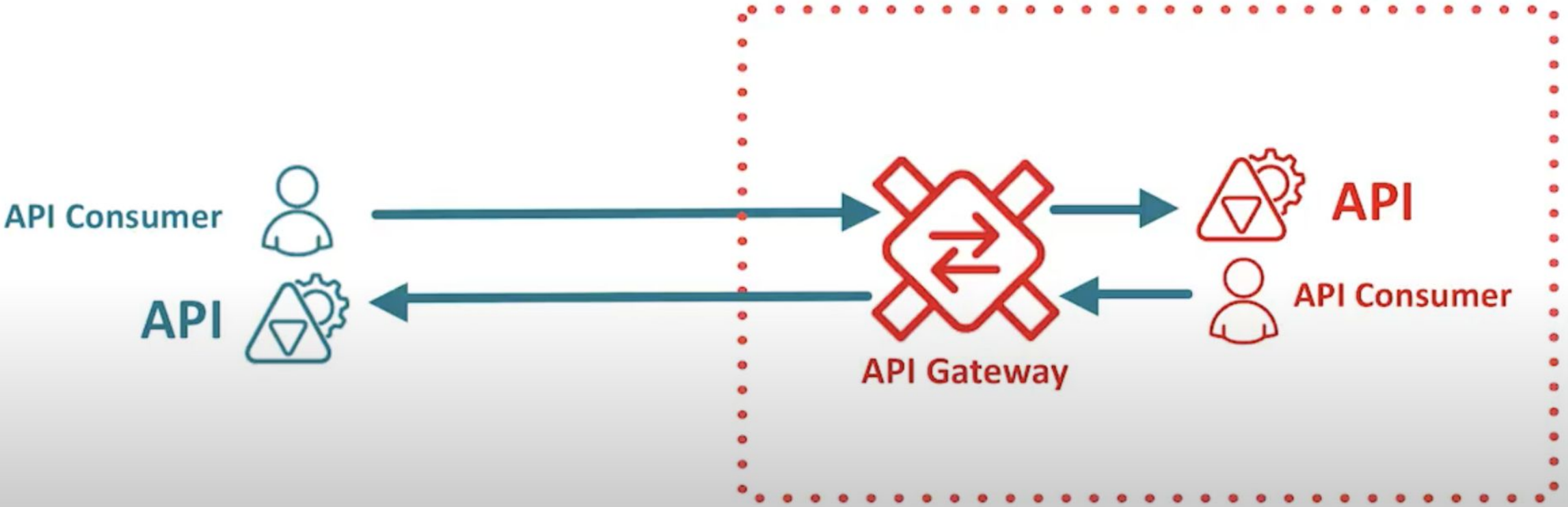
What about API Gateway

DEEPSEC



What about API Gateway

DEEPSEC



BOLA, Mass Assignment & API Gateway

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Legitimate - Client sends a legitimate request

```
PUT /api/v2/users/5deb9097 HTTP/1.1

User-Agent: Mozilla/5.0 (Windows NT
10.0; Win64; x64) AppleWebKit/537.36
(KHTML, like Gecko) Chrome/78.0.3904.108
Safari/537.36
X-Forwarded-For: 19.42.129.253

{
  "_id": "5deb9097",
  "address": "******, NY City, NY",
  "company_role": "Investment Services",
  "email": "******",
  "first_name": "******",
  "full_name": "******",
  "job_title": "Broker",
  "last_name": "******",
  "phone_number": "******"
}
```

Attack – Attackers sends the same request but adds the admin role in the request body

```
PUT /api/v2/users/5deb9097 HTTP/1.1

User-Agent: Mozilla/5.0 (Windows NT
10.0; Win64; x64) AppleWebKit/537.36
(KHTML, like Gecko) Chrome/78.0.3904.108
Safari/537.36
X-Forwarded-For: 19.42.129.253

{
  "_id": "5deb9097",
  "address": "******, NY City, NY",
  "company_role": "Investment Services",
  "email": "******",
  "first_name": "******",
  "full_name": "******",
  "is_admin": true,
  "is_sso": true,
  "job_title": "Broker",
  "last_name": "******",
  "permission_type": "admin",
  "phone_number": "******",
  "role": "admin",
  "sso_type": "admin",
  "system_user_type": "admin",
  "system_user_type_cd": 2,
  "user_type": "admin",
  "user_type_cd": 10
}
```

Legitimate – userId matches in the query parameter and request

Request:

```
GET /v1/customers/15981?userId=207939055
HTTP/1.1

Authorization: Bearer gwwh1Y4epjv9Y

Cookie: _ga=GA1.3.630674023.1502871544;
_gid=GA1.2.1579405782.1502871544;userId=
207939055Host: payments-api.dnssf.com
X-Forwarded-For: 54.183.50.90
```

Response:

```
200 OK

{
      userId: 207939055,
     firstName: "John",
     lastName: "Smith",
     email: "john.smith@acme.com",
     phoneNumber: "+1650123123"
}
```

Attack - Attacker changes the userId in the query parameter

Request:

```
GET /v1/customers/15981?userId=207938044
HTTP/1.1

Authorization: Bearer gwwh1Y4epjv9Y

Cookie: _ga=GA1.3.630674023.1502871544;
_gid=GA1.2.1579405782.1502871544;userId=
207939055Host: payments-api.dnssf.com
X-Forwarded-For: 54.183.50.90
```

Response:

```
200 OK

{
      userId: 207938044,
     firstName: "David",
     lastName: "Miller",
     email: "david.miller@example.com",
     phoneNumber: "+1912456456"
}
```

What about WAF ?

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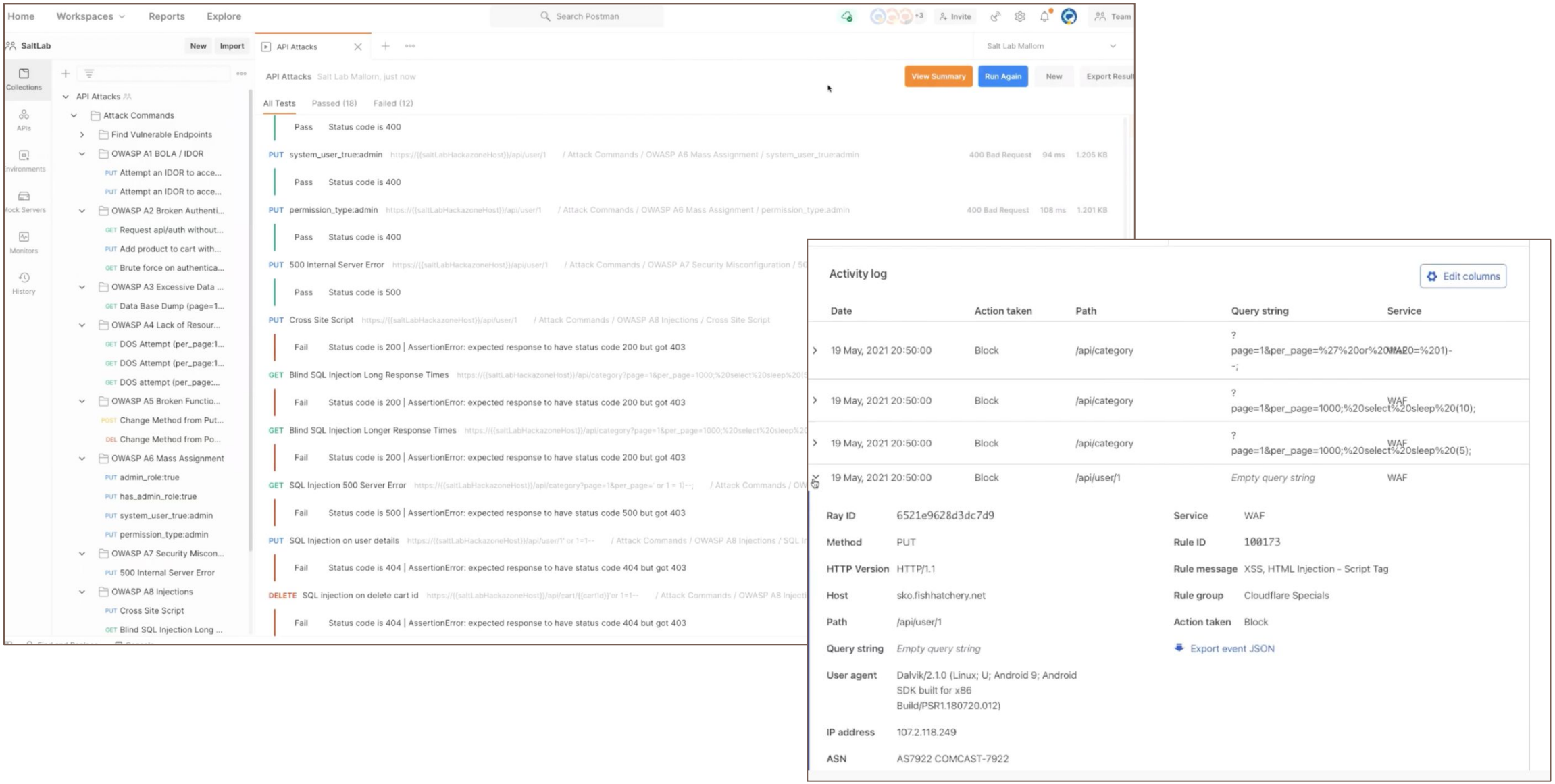

CI/CD Tools (SAST, DAST ...)

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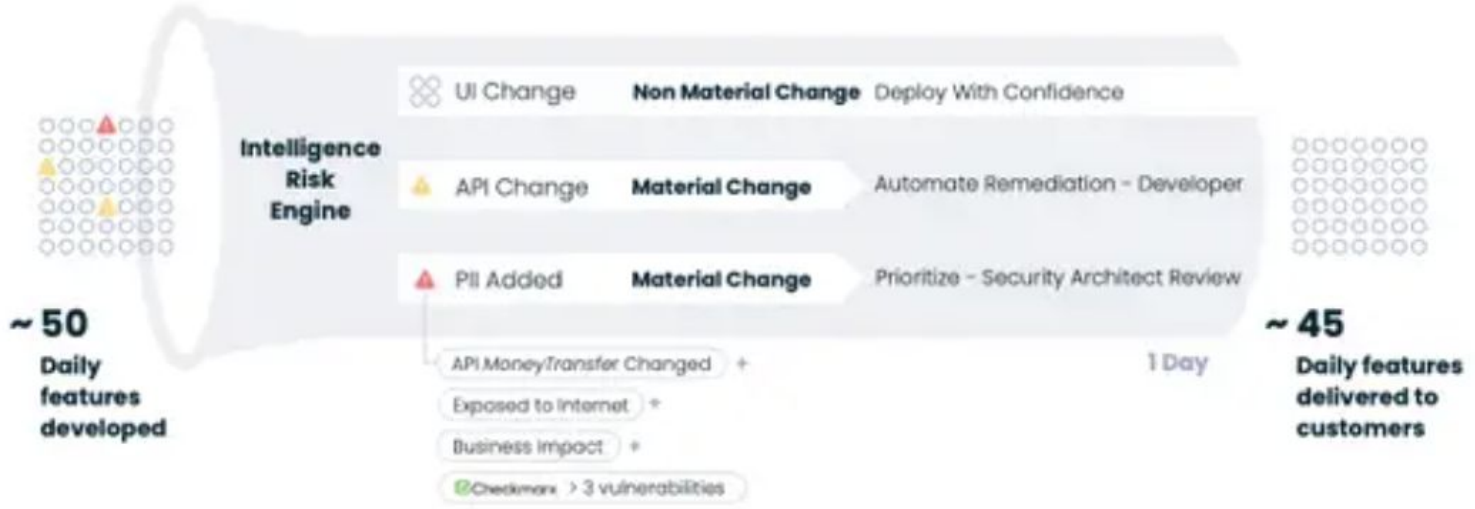
Security of APIs

How are you handling security of APIs?

Data: Dark Reading survey of 173 IT and cybersecurity professionals in Feb



“Positive Model”

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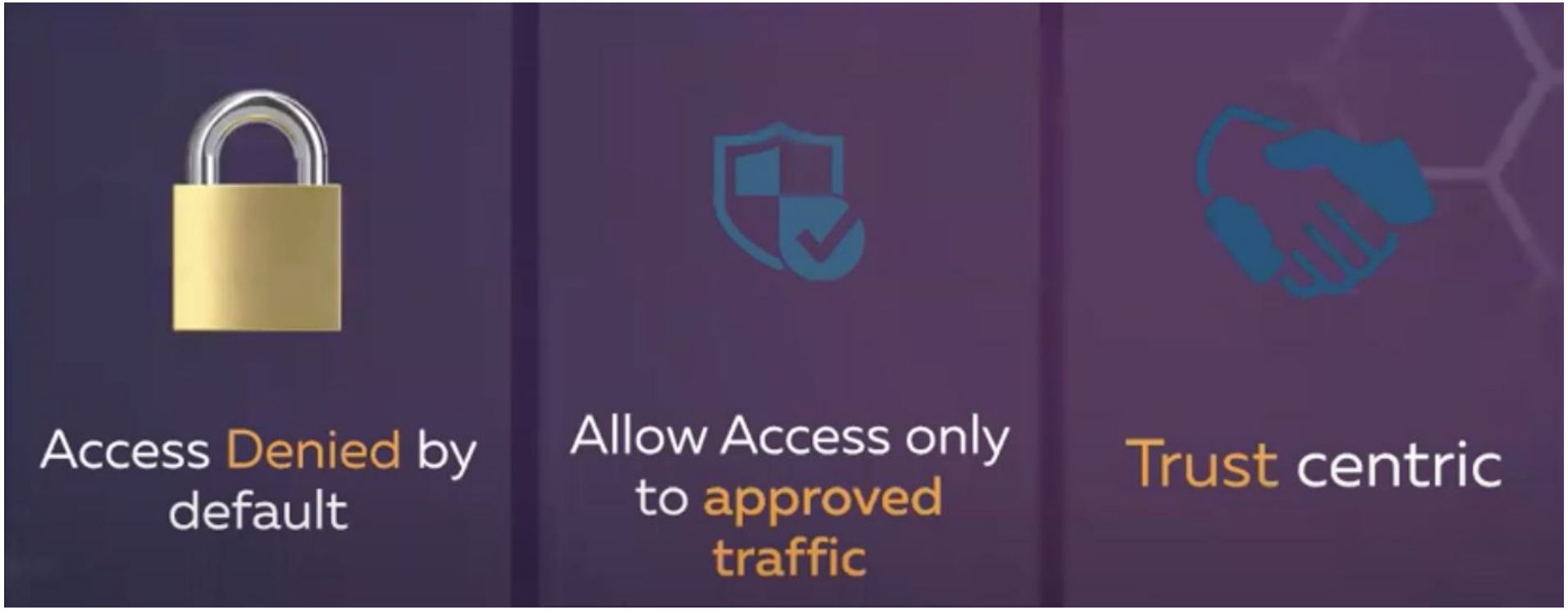

Source: 42crunch

OAS (OpenAPI Specification)

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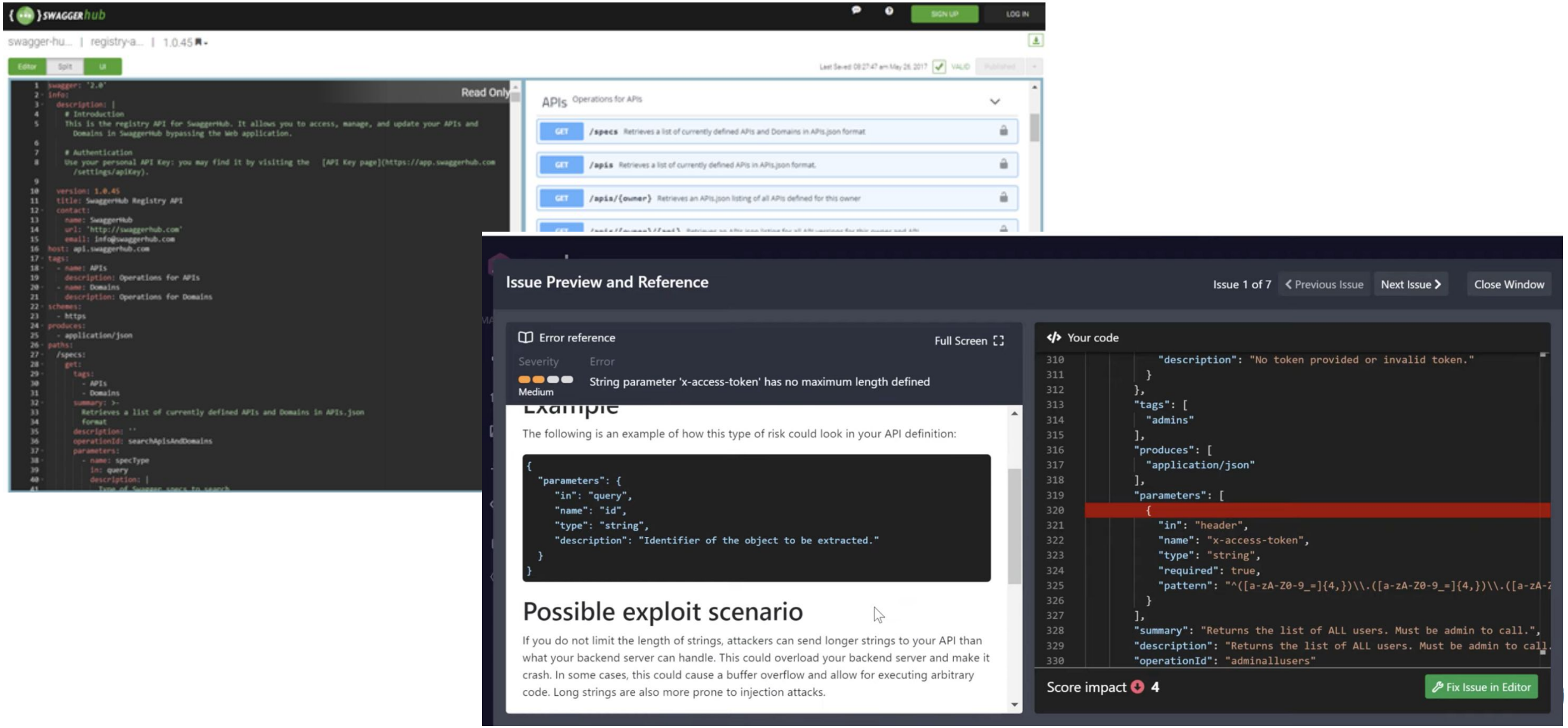

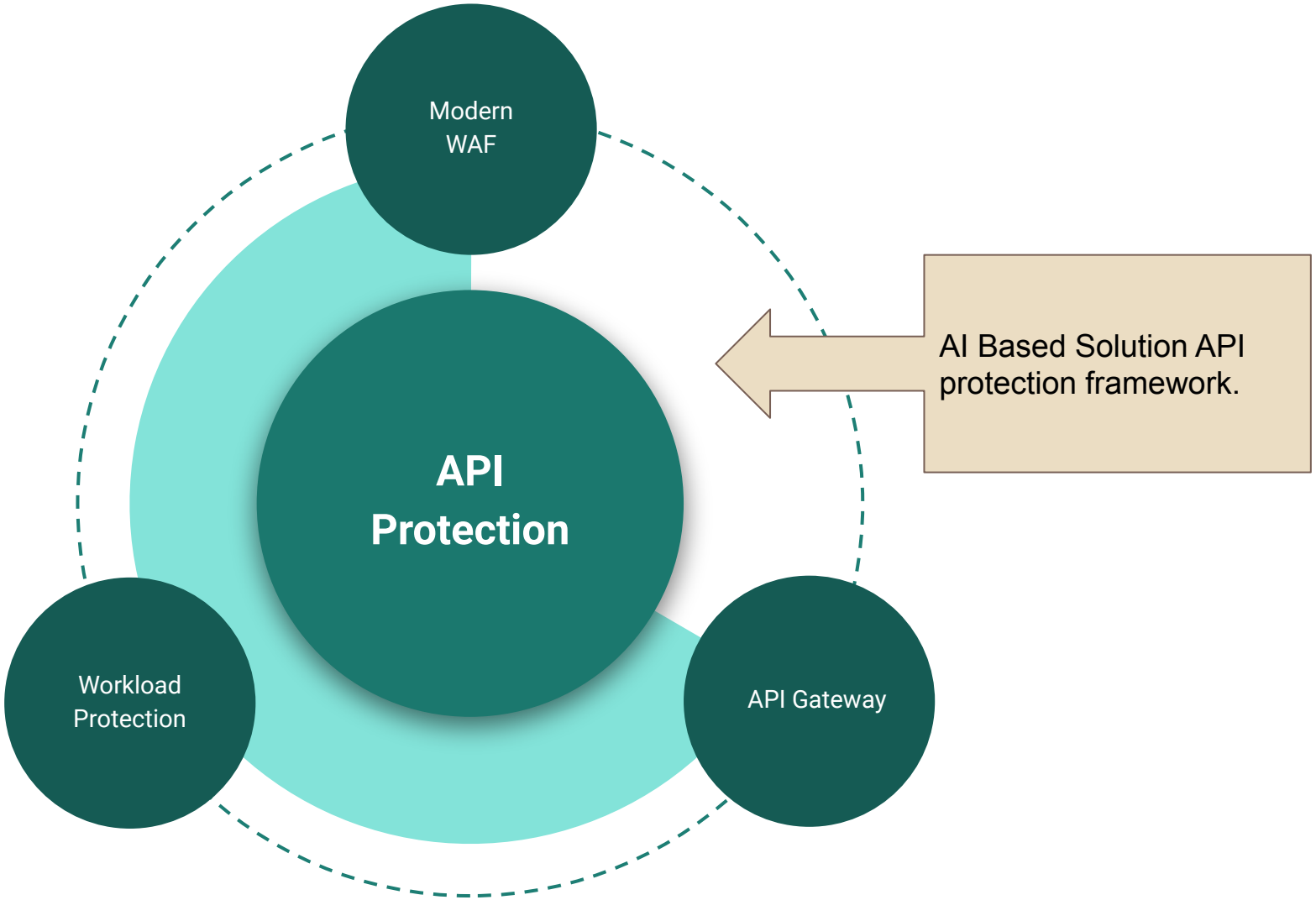
Modern
WAF
API
Protection
Workload
Protection
API Gateway
AI Based Solution API
protection framework.

What we should worry about?

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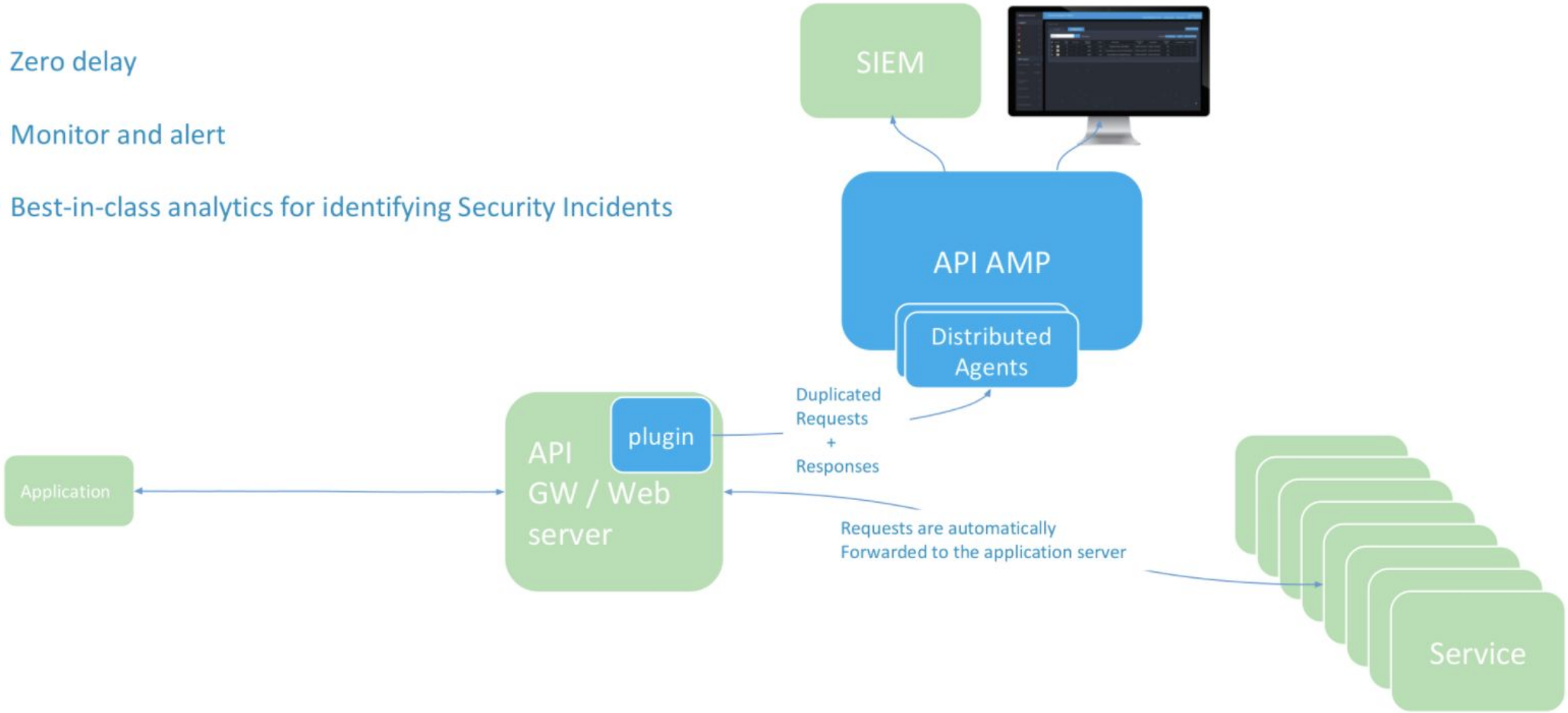
- It's all about statistic
- Learn through legitimate traffic (Cannot stop from the first bad request!)
- Policy creation/correction for *Every API!*
- Take an action (Protect) takes time
- Integrations

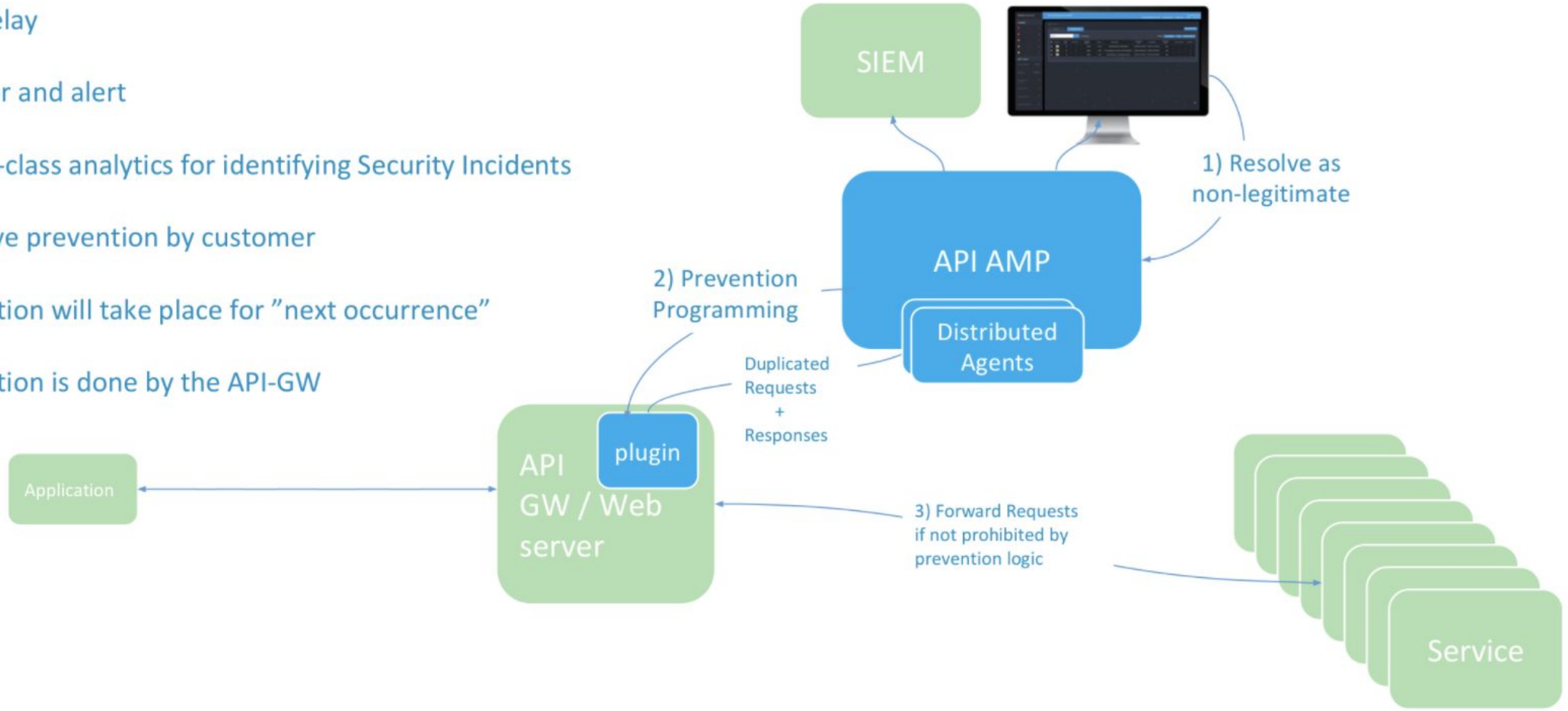
Monitoring only architecture

- Zero delay
- Monitor and alert
- Best-in-class analytics for identifying Security Incidents



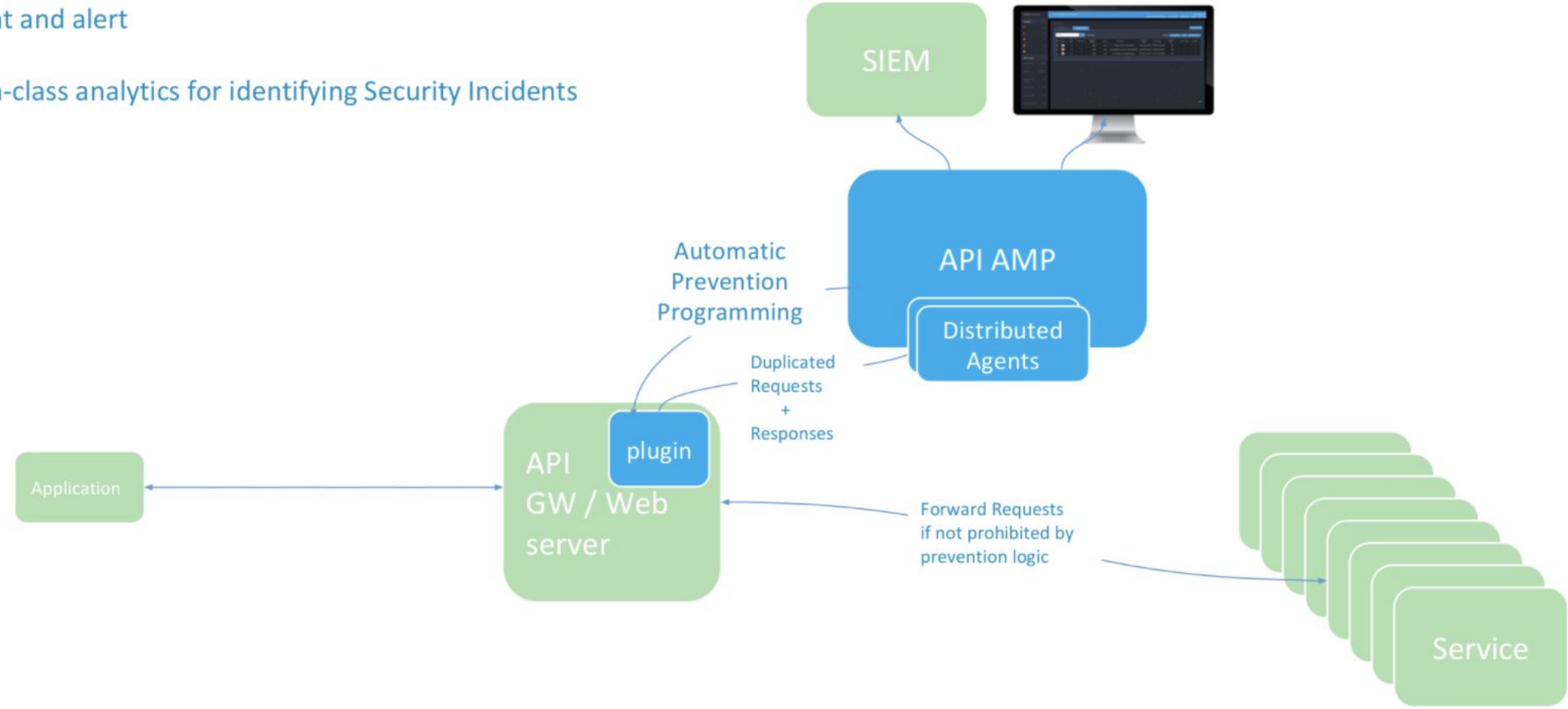
Semi-automatic prevention architecture

- Zero delay
- Monitor and alert
- Best-in-class analytics for identifying Security Incidents
- Selective prevention by customer
- Prevention will take place for ”next occurrence”
- Prevention is done by the API-GW



Automatic prevention architecture

- Prevent and alert
- Best-in-class analytics for identifying Security Incidents



Anomalies Detection

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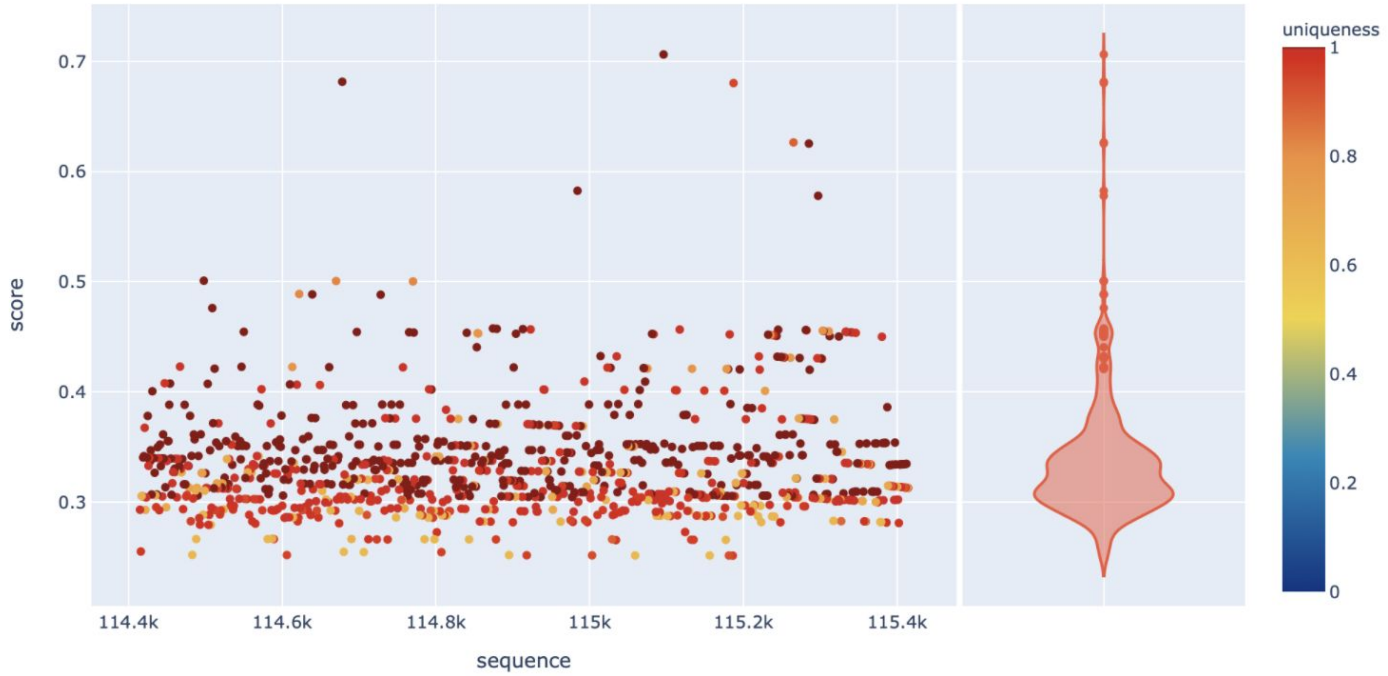
- Self-explanatory Anomaly Descriptions
- Use NLP to auto-generate self-explanatory report of the abnormal API
- anomaly event and incident
- Make it accessible/**understandable** for anyone with basic knowledge of the domain (e.g., Financial service)



“What Did You Say ?”

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Anomaly Management Platform

Anomaly Management Center | Discovery | Management | Logout | programmer

Home > Events > 67d0c8f7-8c04-40e3-8d4a-b6d44458e5d9

Event Number:	Detection Type:	Creation time:	Update date-time:	State:	Activity:	Occurrences:
3	Inconsistent usage	11/25/2019 6:04:21 PM	11/25/2019 6:04:21 PM	Active	Ended	1

< Previous | Next > | Raw packet | Resolve | Delete

Event description:

API call description: Sumbit account recovery code verify

Anomaly description: API usage inconsistency across sequence of 'submit account recovery code verify' API calls

Detected behavior: 'Submit account recovery code verify' API call was used for the same device_id with 9 Inconsistent values

Recommended counter measure:
Rate Limit 'submit account recovery code verify' API calls

Event details:

Application: i.instagram.com/api
Method: POST
Exchange: Request
Host: i.instagram.com
Endpoint: /api/v1/accounts/account_recovery_code_verify
Session ID: N/A
Consumer ID: AKIAJZELQ2XJLOMWKRZA

Inconsistent values: Too many different values of recover_code for device_id

No.	Key field name	Key value	Deviating field	Detected value	Response status
2	device_id	8C21DA6BC4CA07F2	recover_code	000003	403 Forbidden
3	device_id	8C21DA6BC4CA07F2	recover_code	000001	403 Forbidden
4	device_id	8C21DA6BC4CA07F2	recover_code	100002	403 Forbidden
5	device_id	8C21DA6BC4CA07F2	recover_code	999999	403 Forbidden
6	device_id	8C21DA6BC4CA07F2	recover_code	100003	403 Forbidden
7	device_id	8C21DA6BC4CA07F2	recover_code	999997	403 Forbidden
8	device_id	8C21DA6BC4CA07F2	recover_code	100001	403 Forbidden
9	device_id	8C21DA6BC4CA07F2	recover_code	000002	403 Forbidden

User Comments | Add

API Auto Discovery

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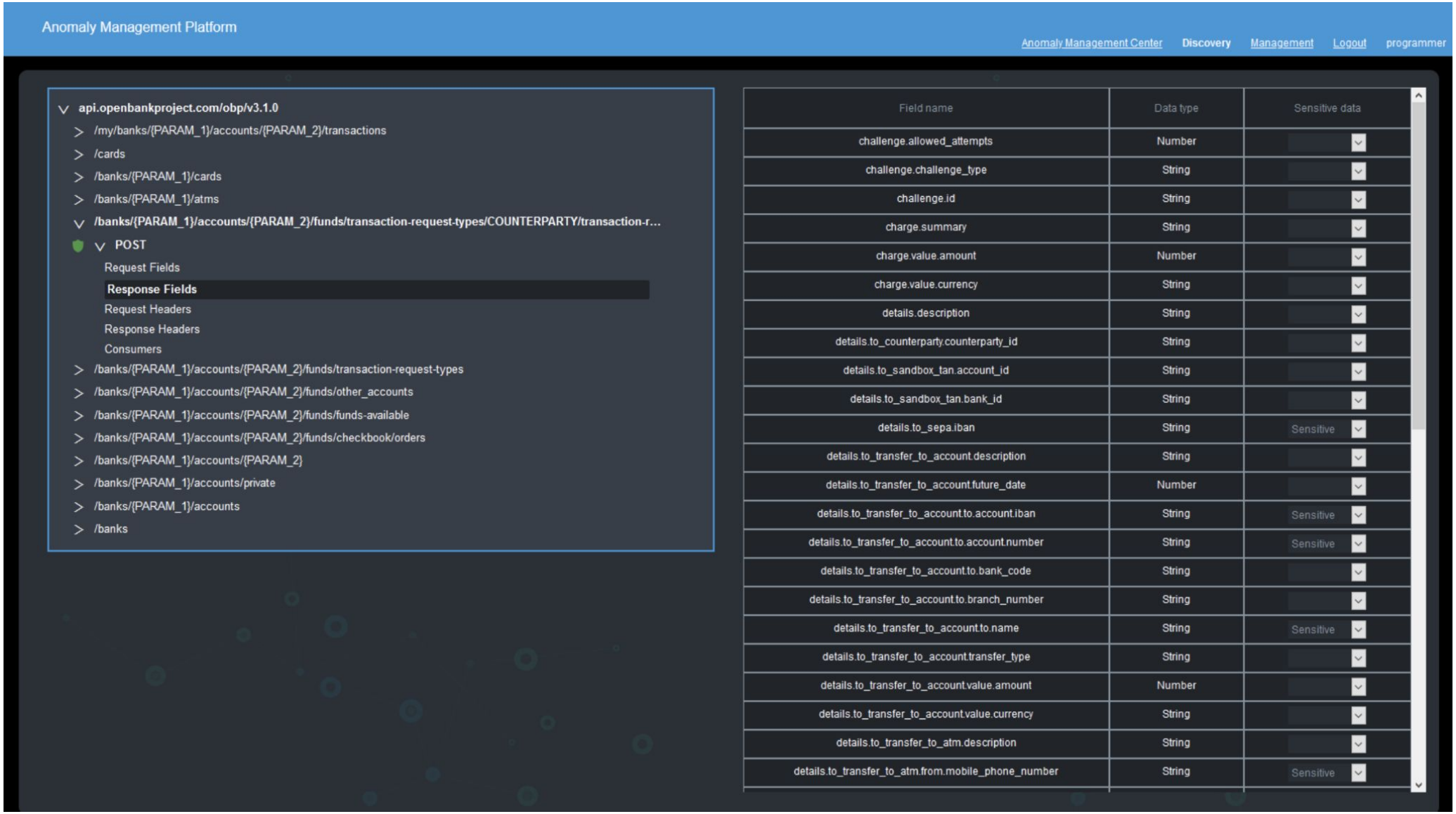

“Connect The Dots” - Visibility

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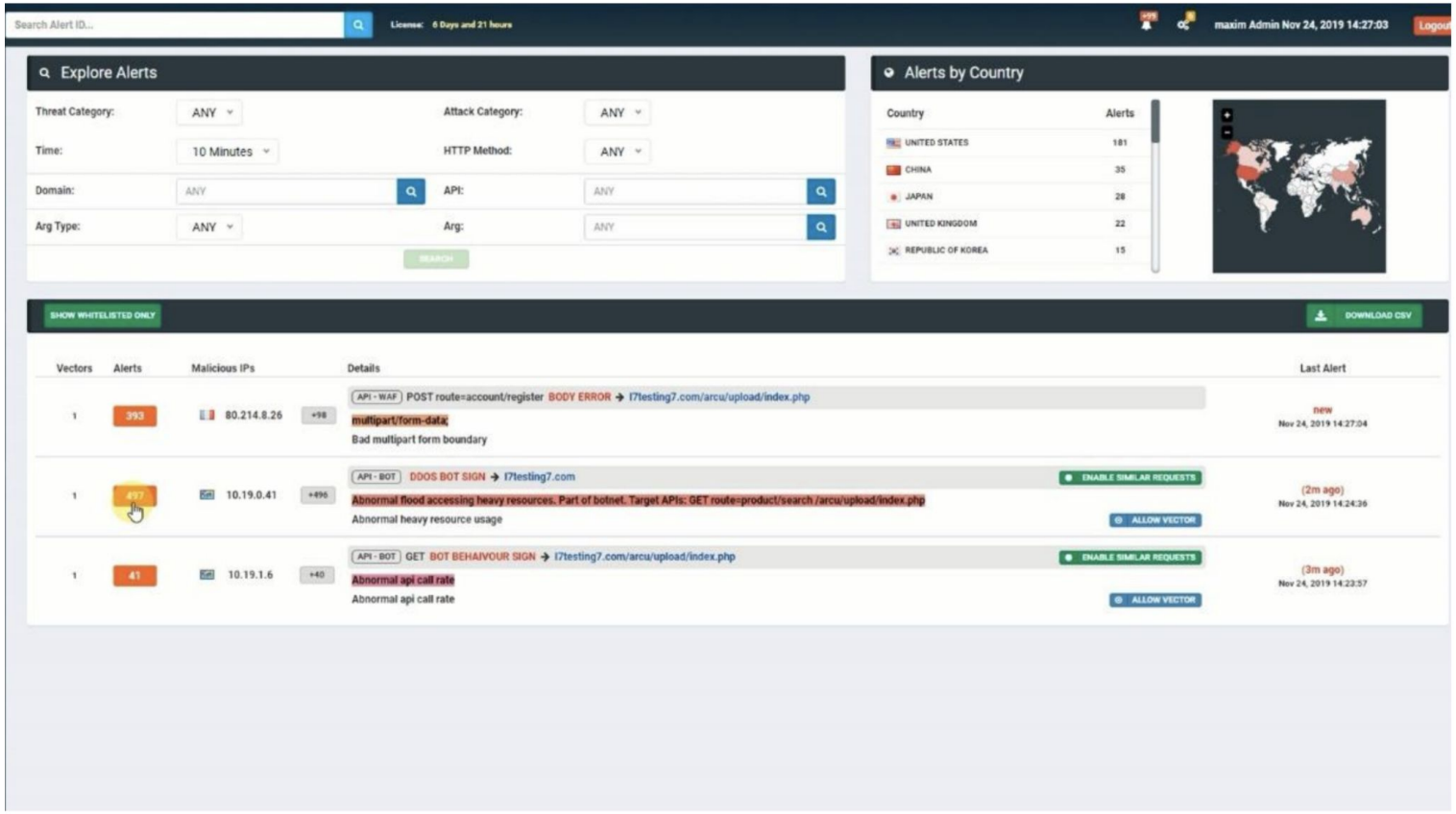
- Smart analytic layer which group and classify API anomalies into intent-driven Attack incident.
- Convert anomalies into the actionable incident by grouping multiple-anomalies with a common attack denominator into an incident.



Attacker "Signature"

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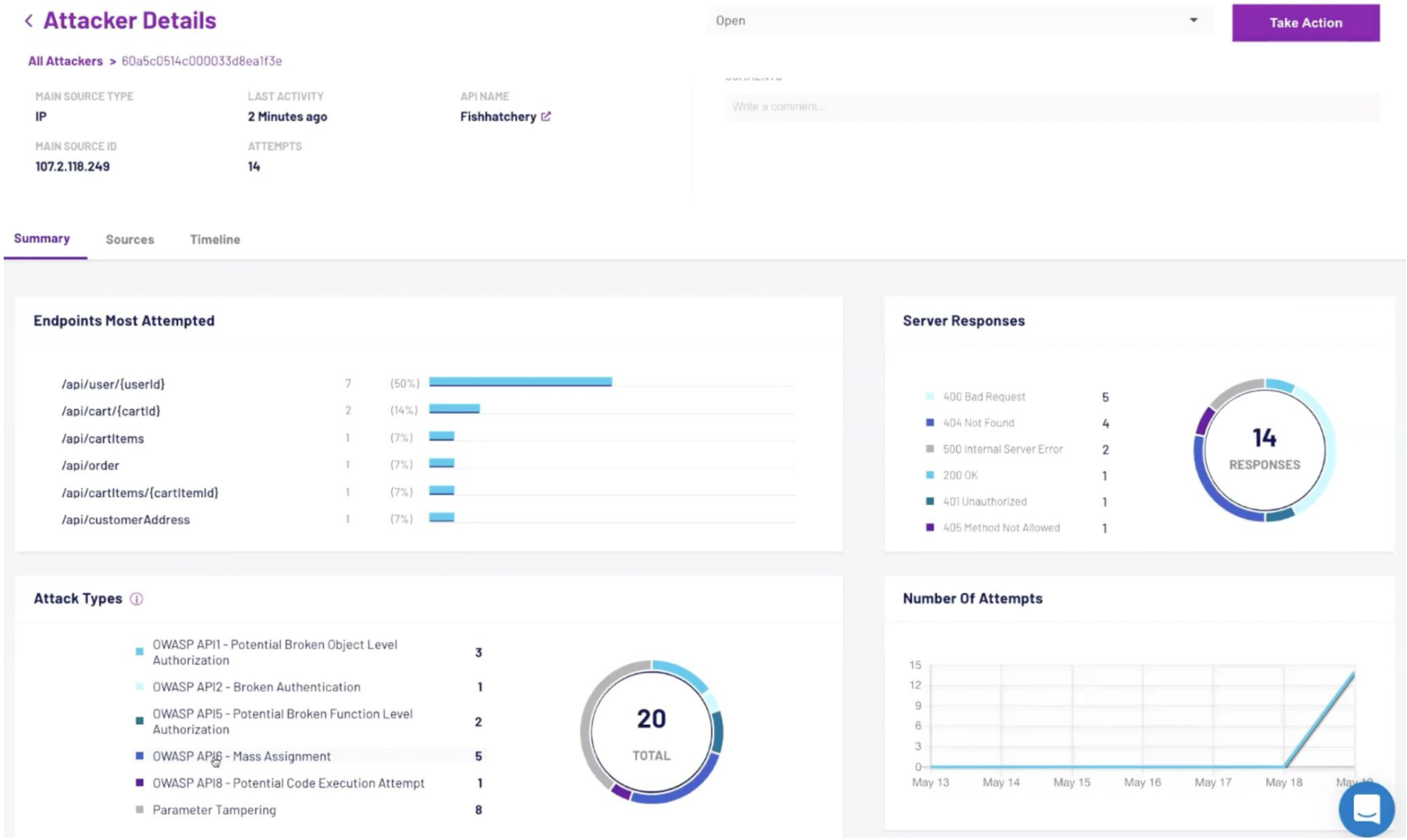

Anomalies Visibility (Find the Risks)

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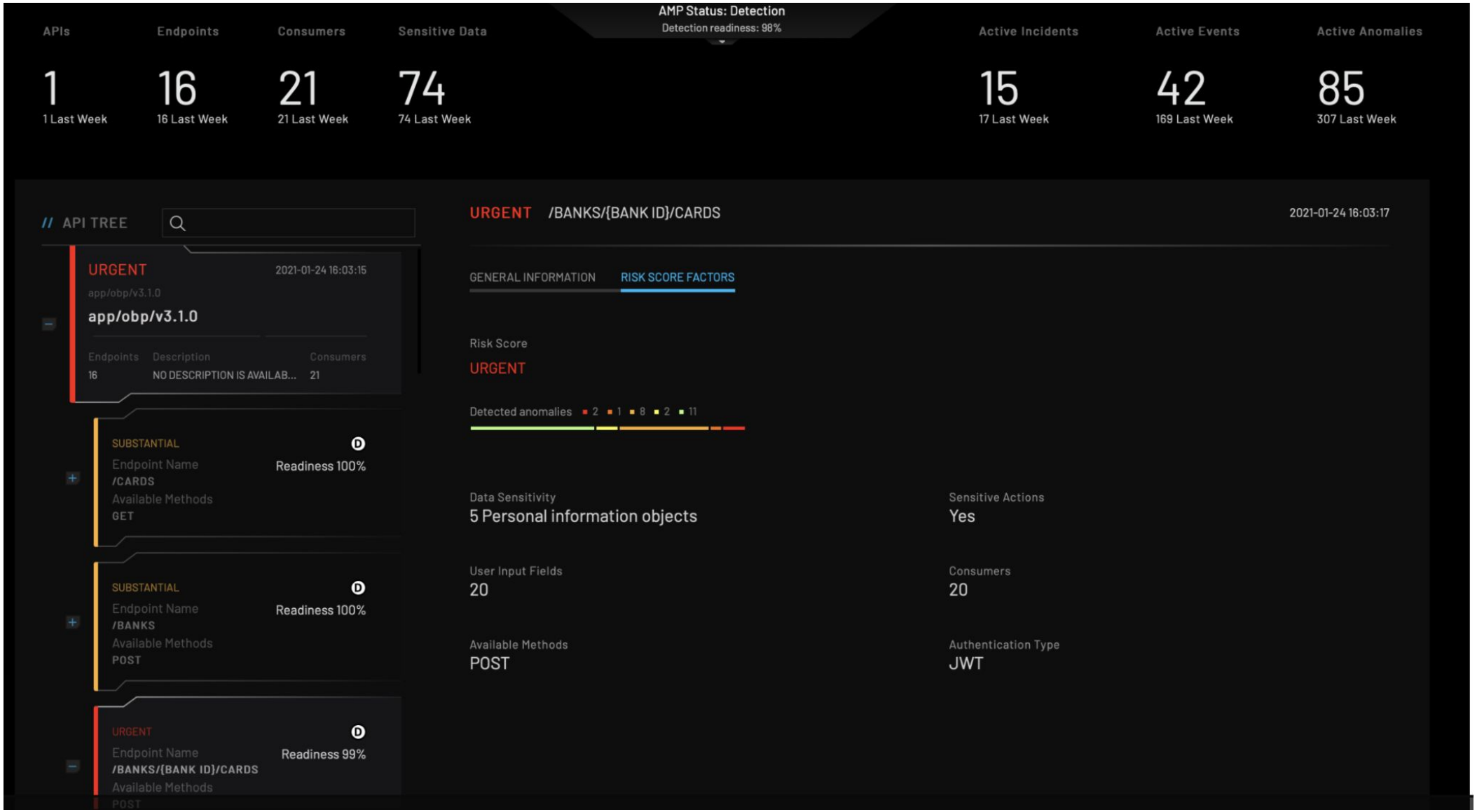

Early detection - Probe Phase

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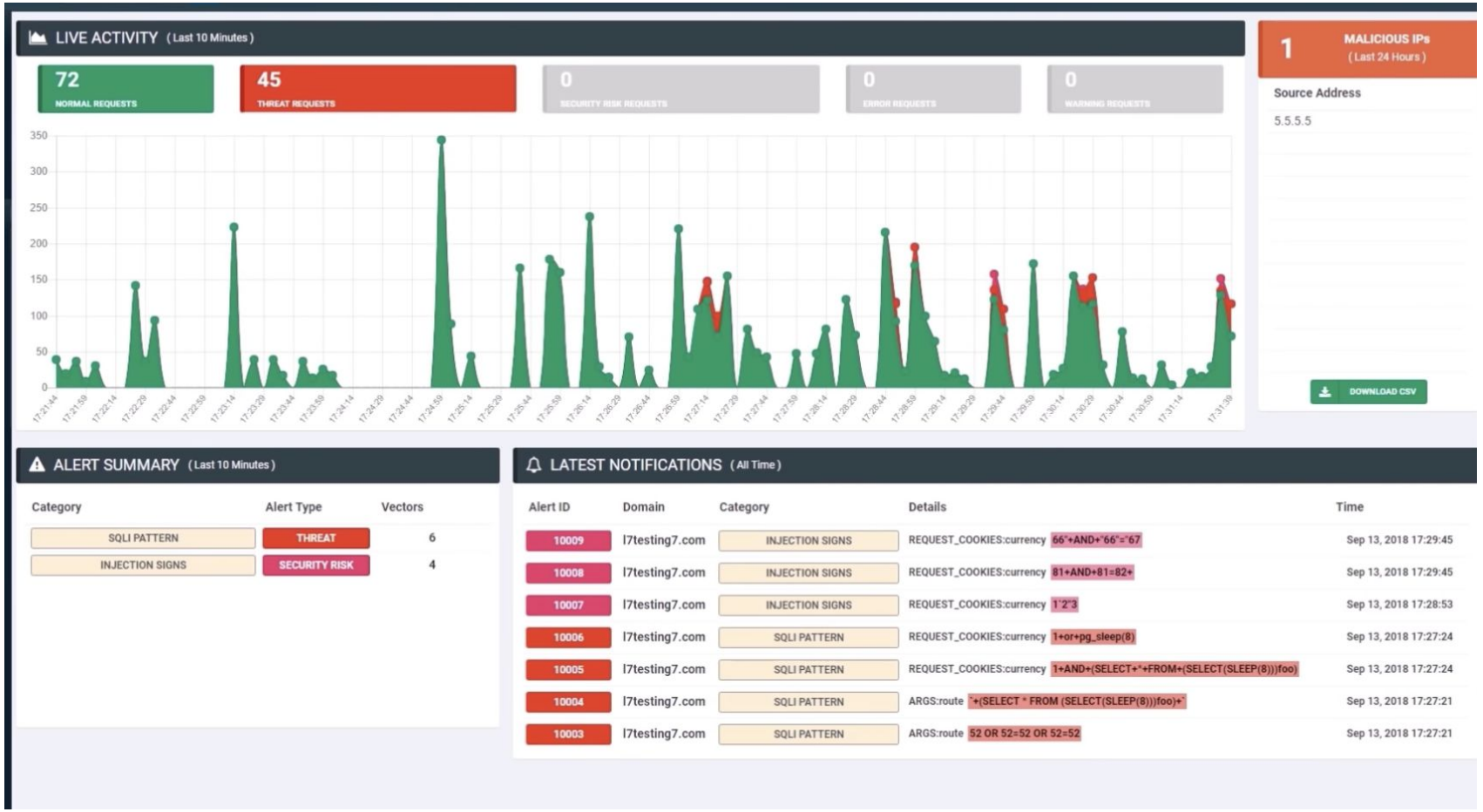
- Taking advantage of “trial and error” hacking patterns
- Identify “attempts-to-attack“ patterns and alert/block the root cause before a successful attack was conducted



“Important” Content Detection

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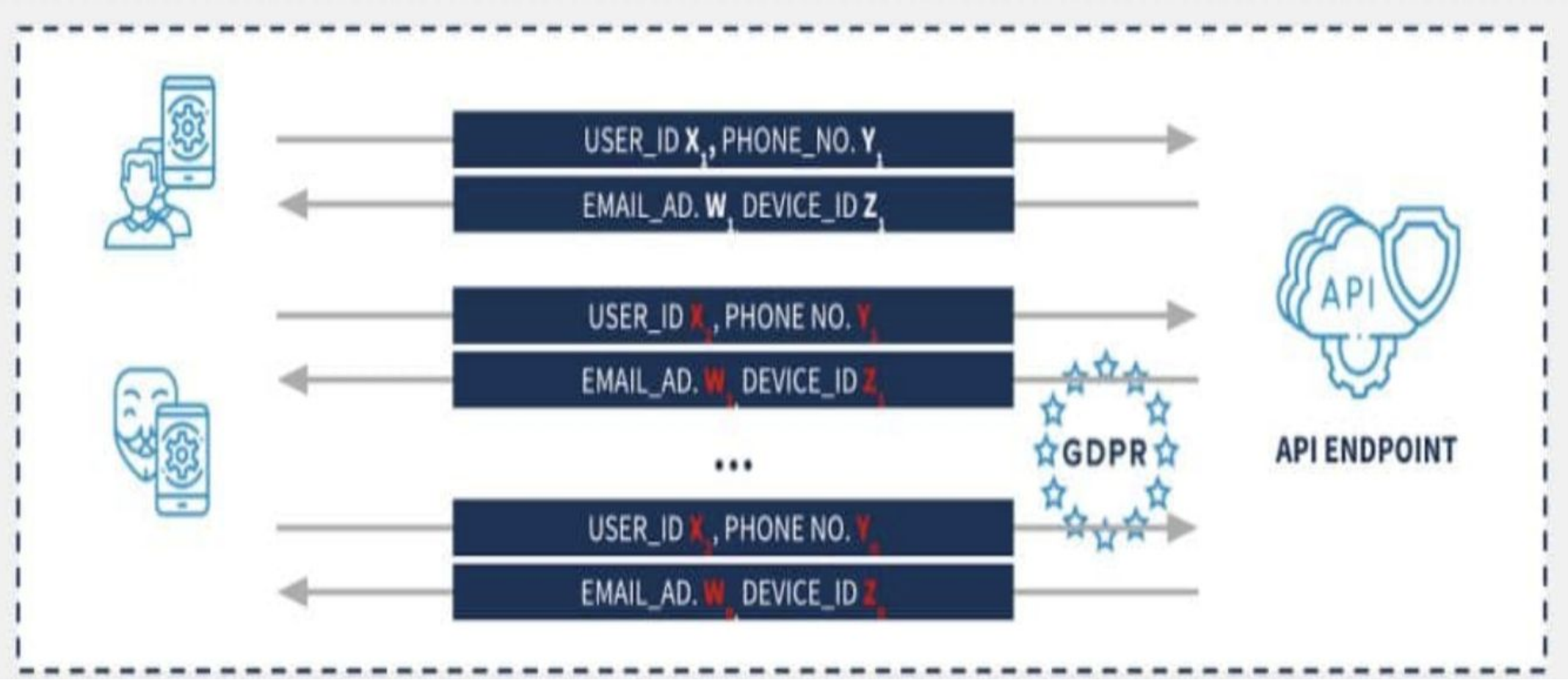

Security Policy as a Code

DEEPSEC

```
var curr_api = getApiData("/v1/hg654/users/*");
var metadata = curr_api.getMetadata();
if(metadata.containsPII(0){
    dashboard.alert("Add PII data is forbidden for this endpoint : " + curr_api.getMetadata().getId());
}else{

//Continue to validate
this.Continue(curr_api);

}
```

Bi-Directional Security (Next Step)

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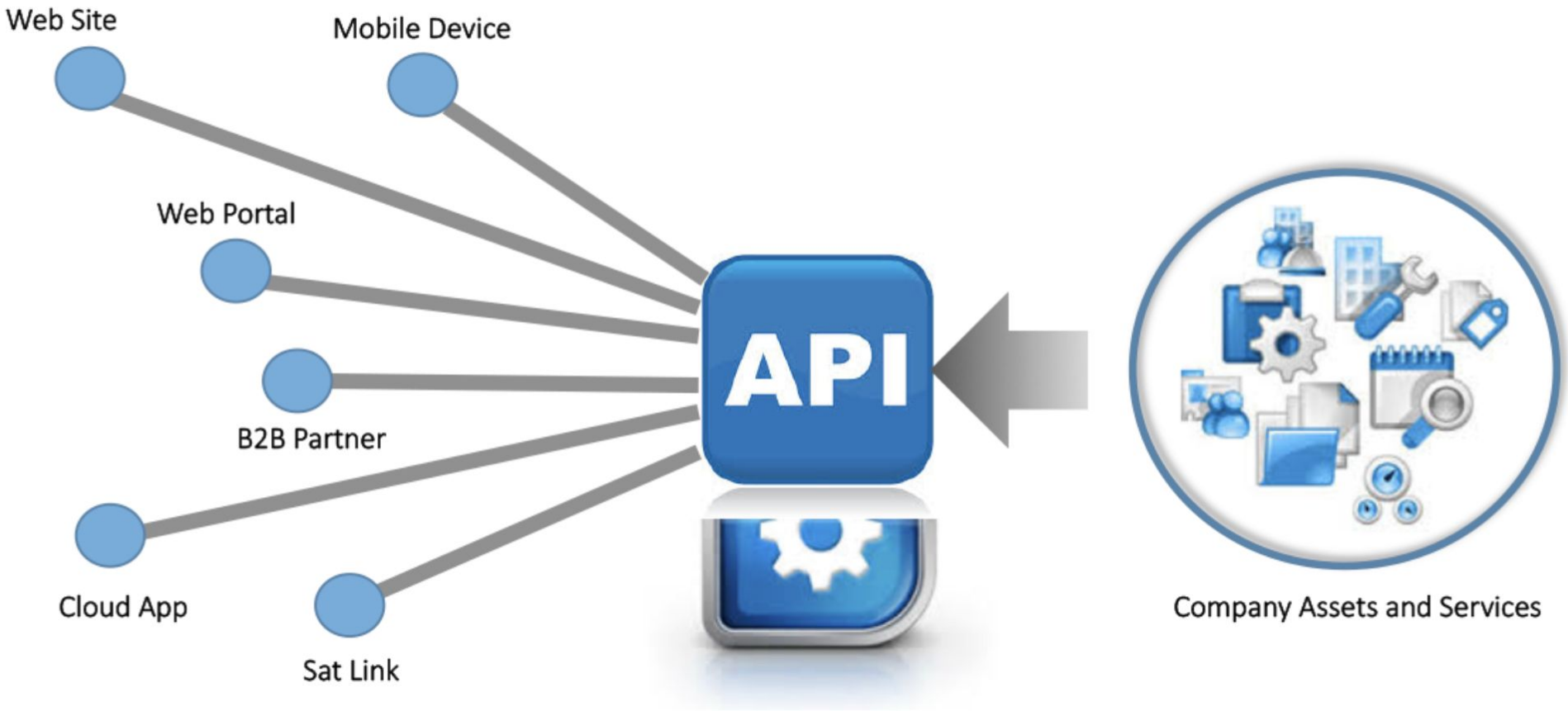

Vendors (Example)

DEEPSEC

SALT

IMVISION

Reblaze

L7 DEFENSE

crunch

Conclusion

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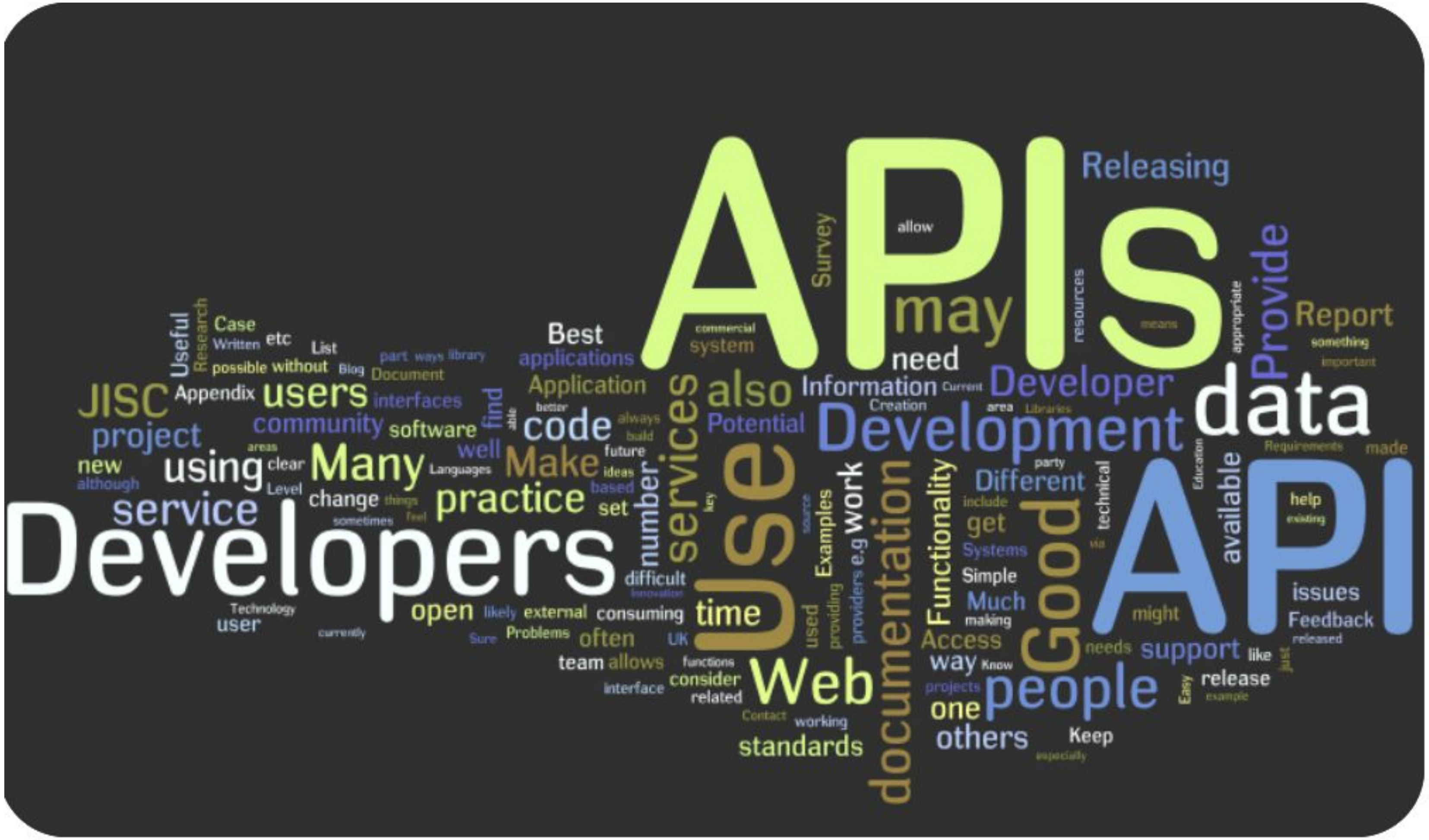

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Thank You!

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