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Business Integration

SEEBURGER Business Integration Suite

API Security – A Brief Introduction

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APIs Today and Tomorrow

Based on market research including input from various industry analysts, it is estimated that in 2021 and 2022 APIs will be the most widely used attack vector on companies and data. With the number of APIs in use growing rapidly, companies must take action to ensure that they are protected, with API security.

What is API Security, and why has it become so important?

API security includes a broad set of design decisions, technical security mechanisms and the overall API management structure to protect APIs, plus the API gateway, backend systems and their provided services – for both the *provide* and *consume* use cases of APIs.

As the number of APIs in use by companies continues to increase, the more data is transferred via APIs, internally, with other companies, and to provide services for consumers. And, with the number of daily API calls and API requests increasing exponentially, it becomes critical that the data is protected. To do this:

- The right data must be provided to the right user at the right time.
- Confidential internal company data, such as financial data, should be accessible only to authorized users.
- Backend systems must be safeguarded against possible overload to avoid failures.
- There must be protection for the API, the gateway, and underlying systems to avoid damage or uncontrolled loss of data through access by third parties or unauthorized persons.

API security includes:

Threat Protection – protects data and systems from malicious intent by fending off attacks against the API and the backend. This requires elements such as content validation or traffic management such as throttling.

Access Control – used for access and rights management, identifies who the calling instance is and whether they have the right to use the API. Access control clarifies which users and applications are allowed to access the API. Topics like OAuth2.0 or JSON Web Tokens or general token validation play a fundamental role here.

The reality is that though API security is important, it is often done improperly, or not at all.

The Effect of Bad API Security Implementation

Venmo's public API is one of the best known cases in the field of API security and what can be done with collected data. Venmo is a mobile payment service owned by PayPal. With the help of the mobile app, after creating a user account, money transfers can be made to other users. When the company started, the focus was on the exchange of money between friends who shared bills, such as when they went to the cinema together, or had dinner together. To use Venmo, you must create an account, and both the sender and receiver must live in the U.S.


```
{"payment_id": 2141499719669514525, "permalink": "", "via": "",
"transactions": [{"target": {"username": "JohnD", "picture": "",
"is_business": false, "name": "Doe", "firstname": "John", "lastname": "D",
"cancelled": false, "date_created": "2020-02-02T16:57:40", "external_id":
"2141499719669514525", "id": "2141499719669514525"}}], "story_id":
"2141499719669514525", "comments": [], "updated_time": "2020-02-
02T16:57:40", "audience": "public", "actor": {"username": "JaneD",
"picture": "", "is_business": false, "name": "Doe", "firstname": "D",
"lastname": "D", "cancelled": false, "date_created": "2020-02-02T16:57:40",
"external_id": "2141499719669514525", "id": "2141499719669514525"}, "type":
"payment", "created_time": "2020-02-02T16:57:40", "mentions": [],
"message": "Miss you", "action_links": {}, "likes": {"count": 0, "data":
[]}},
```


When creating the user account, which can be done either via the mobile app or the website, basic information must be entered. This includes bank account information, debit cards, credit card information, a username, phone numbers and/or email. The recipient can then be found via these data.

Venmo uses a public API. Unless it is changed in the default settings, all transactions between two persons are public for all to see. The transaction contains first and last name, profile photo, a corresponding message, and the Facebook ID, the transaction date as well as the status of the transaction could be accessed. Security researcher Hang Do Thi Duc used this opportunity in 2018 and evaluated all data records from 2017. The API provided a wide range of information. By analyzing and evaluating this data, it was possible to create detailed profiles about individuals, including potential health conditions.

She was able to do this because the public API provides private information and was not securely configured, and data filters, authentication and authorization mechanisms for the retrieval of data were not available. There were also other serious security mistakes which can be found in OWASP API Security Top 10 – "massive data exposure and no security by design."

Imagine if this was your critical business data.

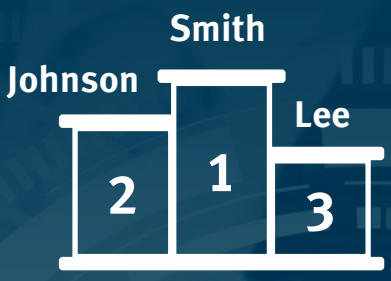
Please find a graphic featuring information Hang Do Thi Duc found because of the insecure API used by Venmo on the next page.

What Can Happen When APIs Are Not Secure

1,731,783
Facebook IDs

207,984,218
Transactions

18,429,464
Humans



Most frequent last names

Busiest weekend
December 1-3, 2017
2,342,411 transactions

2,979,616 transactions for pizza

Profiles

YOLOist

- Female with a Greek name
- Friends live in Texas and Mexico City
- 865 transactions for soda, alcohol, fast food and sweets in 8 months
- Uses 1-2 words or an emoji to describe things
- Follows routines

The All Americans

- Couple
- Own a car and a dog
- Favorite pizza is Shakey's
- Live in Orange County, CA
- Brand name shoppers
- Visit theaters
- Favorite grocery store is Walmart
- Goes shopping more than once a week, but never on Wednesdays or Sundays

https://publicbydefault.fyi/

Protecting Your Data: Mechanisms and Technology

Auth (n/z)

Auth (n/z) stands for *authentication* and *authorization*. Authentication and authorization are broad terms using multiple approaches to secure, identify and enforce rights management. Authentication deals with the identity of the user. For authentication mechanisms are implemented which answer two questions: Is the person who he/she claims to be, and who is the person? Authorization, on the other hand, is used to answer the question, what is this person allowed to do? For example, it decides what data the requesting instance is allowed to see.

As a practical example, take a journey by train or a flight. During check-in, the identity card is shown, which authenticates the person, as it clearly shows who the person is. The plane or train ticket represents the authorization token. It indicates what the person is allowed to do. In this case, it shows which flight they are on and where the person may sit. Within APIs, auth (n/z) identifies who calls the corresponding API and what rights this person has, i.e. what this person is allowed to do or what data a calling instance is allowed to see.

> Hello, I am John Doe.
> Here, look at my identity card.
>
> *– Authentication –*

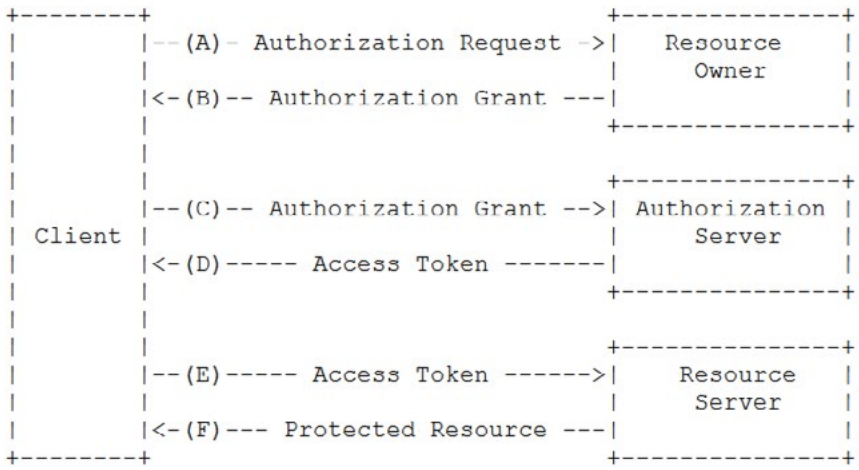
> I have the permission to sit in this seat.
> Here is my plane ticket.
>
> *– Authorization –*

OAuth2.0

OAuth2.0[1] represents the standard for authorization of a third party to obtain access to resources, which belong to someone else – RFC 6749. OAuth2.0 gives websites or applications access to someone else's data without forwarding the actual password to them.

OAuth2.0 has four roles:

1. Resource owner: Owner of the requested resource that allows the client to use the resource.
2. Client: The requesting instance that wants to use a resource.
3. Resource server: The resource server hosts the protected resource requested by the client and belonging to the resource owner.
4. Authorization server: Identifies and authenticates the user and issues access tokens to the client.



A well-known OAuth2.0 example shows the connection between Pinterest and Facebook. Within the online pin board, Pinterest, users can add their own Facebook friends as contacts. For this purpose, Pinterest has to access the user's Facebook information, but without receiving the user's Facebook log-in data. That's where OAuth2.0 comes in.

The user (resource owner) is shown a window by Pinterest (client) for the login on Facebook. The user logs in and grants Pinterest access. Pinterest can now request an access token from Facebook's Authorization Server and with the help of this token, request the resources – in this case the user's contacts – from the Resource Server. Pinterest now receives the resource as a protected resource. Pinterest only has the rights that it has requested and that the resource owner approves during the entire process and does not know about the user's login data on Facebook.

Grants include

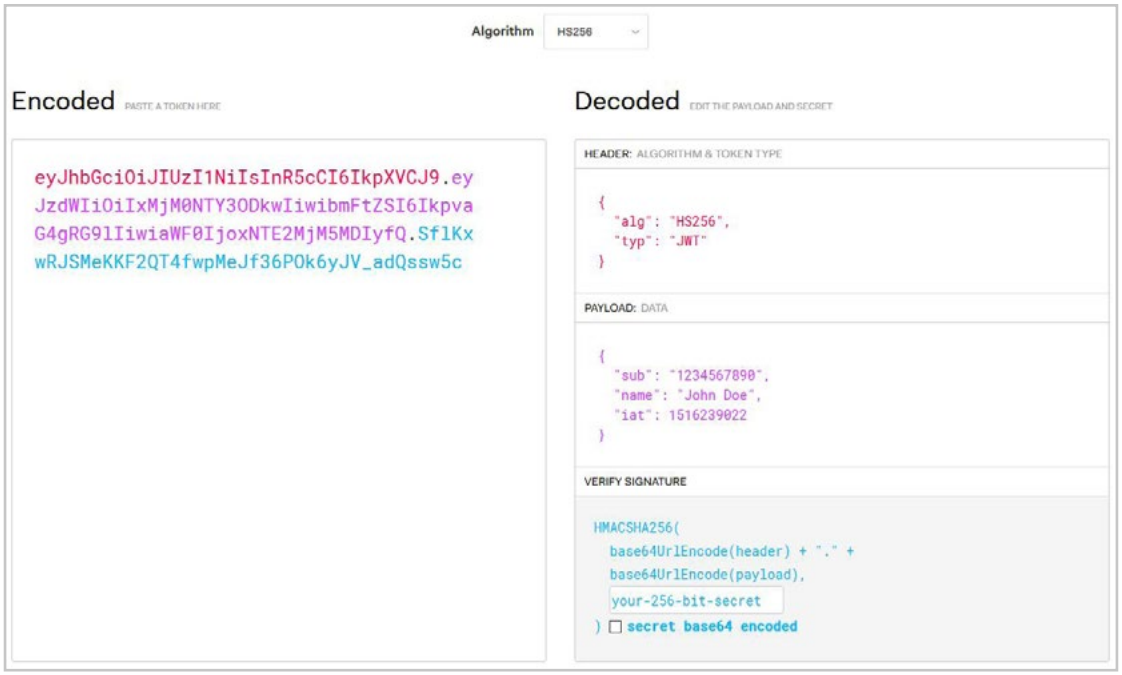
- Authorization code
- Implicit
- Resource owner password credentials
- Client credentials

[1] https://tools.ietf.org/html/rfc6749

JSON Web Token

A JSON Web Token (JWT, pronounced /dʒɒt/) is an access token using JSON as a basis. It can be used within the OAuth2.0 flows as the access token, which the Authorization Server grants the client. The token is a string that is passed in the header or as a request parameter. Information is exchanged between two parties using the verified claims contained in the JWT. As an open standard (RFC 7519)[2] JWT provides a secure and compact way to exchange this information. Information in the JWT is digitally signed and therefore trustworthy. JWT is a type of container that defines the form of the information that is sent back and forth.

A JSON Web token always consists of three parts, which are marked in the following figure by the three colors red, pink and blue.



https://jwt.io/

Header (red)
The header indicates which algorithm was used to sign the token. In this example, it is HMAC SHA256, which is represented by “alg”: “HS256”. The token type, JSON Web Token, is also specified. The data stored in JSON format is Base64 encoded.

Payload (pink)
The payload represents the actual information in JSON format. The key/value pairs representing the information are called claims. The payload in the example contains the information “sub”, “name” and “iat”. Exactly like the header, the payload is also Base64 encoded.

Signature (blue)
The signature is derived from the header and is defined using the algorithm standardized in RFC 7515. After that, the signature is – exactly like header and payload – Base64-encoded.

[2] https://tools.ietf.org/html/rfc7519

The Central Point for API Security Implementation: The API Gateway

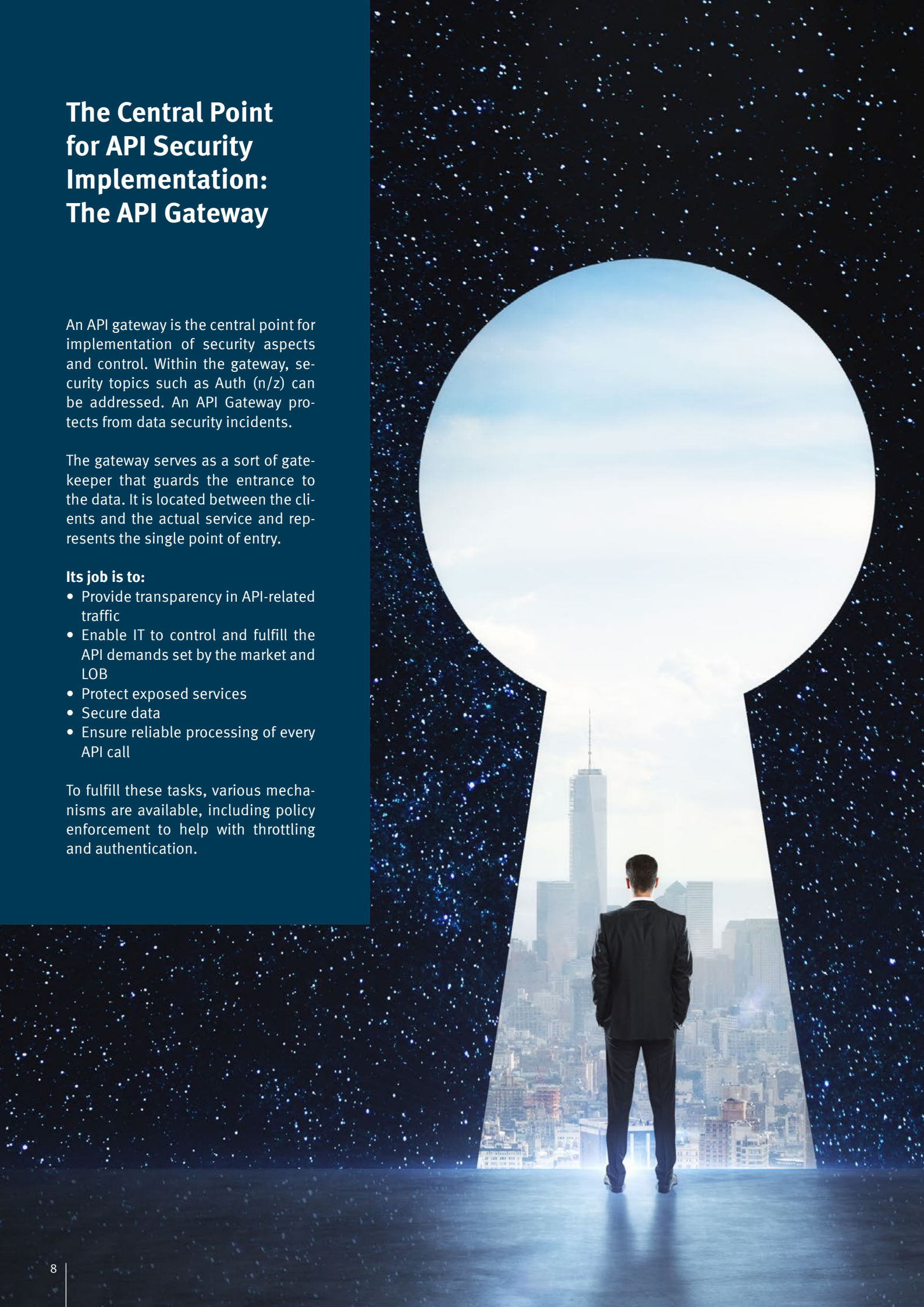
An API gateway is the central point for implementation of security aspects and control. Within the gateway, security topics such as Auth (n/z) can be addressed. An API Gateway protects from data security incidents.

The gateway serves as a sort of gatekeeper that guards the entrance to the data. It is located between the clients and the actual service and represents the single point of entry.

Its job is to:

- Provide transparency in API-related traffic
- Enable IT to control and fulfill the API demands set by the market and LOB
- Protect exposed services
- Secure data
- Ensure reliable processing of every API call

To fulfill these tasks, various mechanisms are available, including policy enforcement to help with throttling and authentication.



SEEBURGER Business Integration Suite's API Gateway

A general full lifecycle API management solution, such as SEEBURGER's API Management Solution, helps to capture and control the consumed and provided APIs. One of the essential components of an API management solution is the API gateway, which also plays an important role in the area of API security.

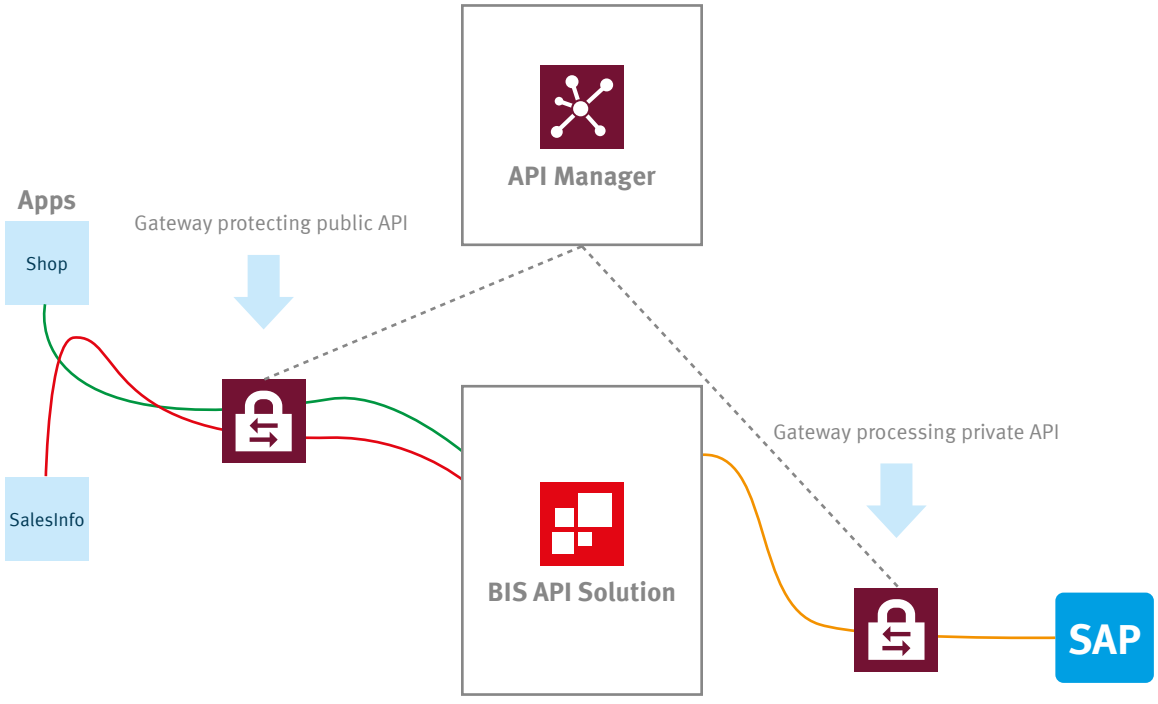
SEEBURGER API Gateway is a preconfigured shipped part of the BIS API Management Solution. All data traffic related to APIs goes through the gateway, which is the central point of the solution. Using the API Gateway increases transparency, controls data flows, helps protect exposed services, secures data and provides reliable processing of every API call.

Although multiple gateways can be used in parallel or sequentially, they are not managed individually, but centrally via a single GUI – the BIS API Manager. Install the gateway(s) with the help of the BIS Landscape Manager, and receive manual, partial or fully automated updates, depending on your needs.

The following figure shows the data flows between calling instances, and public and private APIs through two gateways, which are centrally managed by the BIS API Manager.

Supported functionality

- Supports parallel operations of several instances (Active / Active) and ensures scaling, high availability, and updates without downtime.
- Provides a user exit, in the event that an individualization deviating from the SEEBURGER standard, is required.
- Comes with a comprehensive set of predefined policies that can be easily expanded by using Policy Designer capabilities in Developer Studio.
- Functions of the BIS API Gateway are based on the http adapter layer.
- Uses in-memory channel processing.
- Minimal latency.



Policy Architecture

Policies are rules that serve to design and secure the underlying services and therefore determine the behavior of the API. Policies can be assigned to different groups, such as traffic management or security. The structure of a policy is always the same - at least one rule to be checked and the resulting action to be executed. All of this happens inside the API gateway, which is responsible for policy enforcement.

BIS API Gateway checks policies based on the http request information:

- Caller IP
- URL, which consists of Protocol, Host, Port, Path, Query Parameters
- (http://petstore.swagger.io:80/v2/pet/5?name=dog)
- Header = a set of key/value pairs
- Content
  - REST: content = payload
  - WebService define SOAP content with additional SOAP Header, payload is inside
- AS2 uses S/mime with additional headers, payload inside

Rate-limit-by-key

It is important to restrict the number of times an API can be called within a certain time range, for example, to protect the backend systems which can only handle a certain amount of requests in a certain time period, or to protect against DoS attacks.

```
rate-limit-by-key {
    @calls := 10
    @renewal-period := "M1"
    @refresh-increment := 60
    @counter-key := "key-to-limit-call"
}
```

Parameter	Description
Calls	The maximum number of calls that can be done before 429 “too many requests” is returned. Checks the counter service to see whether the counter for the given key has exceeded the maximum or not.
Renewal-period	Renewal-period in which the counter service will decrement the counter. Possible values: • “S10” – 10 seconds • “S30” – 30 seconds • “M1” – 1 minute • “M10” – 10 minutes • “M30” – 30 minutes • “H1” – 1 hour
Refresh-increment	In case the number of calls exceeds the accepted limits, all further calls are blocked until the renewal period is over. After this, the counter value is decremented by the value set in refresh-increment.
Counter-key	The name of the key that we are using to limit the number of calls. Each time a call is done, a counter for the given key will be incremented.

Validate-jwt

As mentioned above, JWTs are a common type of access token which contain user information and permissions. It is important to validate any given JWT. If validation fails, a force reply will be given. Otherwise, the request is simply forwarded to the next set of policies.

```
validate-jwt {
    @header-name := "some-header-name"
    @failed-validation-httpcode := 409
    @failed-validation-error-message := "Access Denied"
    @token-value := "eyJhbGciOiJIUzI1NiIsInR5cCI6IkpXVCJ9.eyJzdWIiOiIxMjM0NTY3ODkwIiwibmFtZSI6IkpvaG4gRG9lIiwiaWF0
    @require-expiration-time := "false"
    @require-signed-tokens := "true"
    issuer-signing-keys {
        key := "secret"
    }
    audiences {
        audience := "test-audience"
    }
    issuers {
        issuer := "test-issuer"
    }
}
```

Parameter	Description
Header-name	The name of the header that contains the JWT token. If the attribute “token-value” is already set, this will be ignored.
Failed-validation-httpcode	The http code that the user will obtain as response when the validation fails.
Failed-validation-error-message	The message that the user will obtain as response when the validation fails.
Token-value	The JWT
Require-expiration-time	“true” or “false”. Setting this to “false” means that using an expired JWT token is allowed.
Require-signed-tokens	“true” or “false”. Setting this to “false” means that the JWT token will not be validated against the “signing-key”.
Issuer-signing-keys	Contains all the keys that will be used to validate the JWT token. You can add multiple keys and they will be validated one by one until the correct key is found or all the keys have been tested.
Audience	Lists the expected audiences. The token will be validated to see whether the expected audiences match the token’s target audiences.
Issuers	Lists expected issuers. The token will be validated to see whether the token’s issuer can be found in the list of expected issuers.

OWASP Open Web Application Security Project

https://owasp.org/

Today's API Security Risks

The information in this document about threats and protection mechanisms is by no means exhaustive. The possibilities of attack are at least as varied as the possible protective measures. When it comes to the security of web applications and APIs, Open Web Application Security Project (OWASP) is an authority. OWASP is a community that published its first security document in 2003. Since then, there have been documents, tools, videos and the OWASP forum covering a multitude of topics on security. In 2019 OWASP started focusing on specific topics within API security, and have now published what are considered the top 10 security risks.

Threat	Description
API1:2019 – Broken Object Level Authorization	APIs tend to expose endpoints that handle object identifiers, creating a wide attack surface Level Access Control issue. Object level authorization checks should be considered in every function that accesses a data source using an input from the user.
API2:2019 – Broken User Authentication	Authentication mechanisms are often implemented incorrectly, allowing attackers to compromise authentication tokens or to exploit implementation flaws to assume other user's identities temporarily or permanently. Compromising system's ability to identify the client/user, compromises API security overall.
API3:2019 – Excessive Data Exposure	Looking forward to generic implementations, developers tend to expose all object properties without considering their individual sensitivity, relying on clients to perform the data filtering before displaying it to the user.
API4:2019 – Lack of Resources & Rate Limiting	Quite often, APIs do not impose any restrictions on the size or number of resources that can be requested by the client/user. Not only can this impact the API server performance, leading to Denial of Service (DoS), but also leaves the door open to authentication flaws such as brute force.
API5:2019 – Broken Function Level Authorization	Complex access control policies with different hierarchies, groups, and roles, and an unclear separation between administrative and regular functions, tend to lead to authorization flaws. By exploiting these issues, attackers gain access to other users' resources and/or administrative functions.
API6:2019 – Mass Assignment	Binding client provided data (e.g. JSON) to data models, without proper properties filtering based on a whitelist, usually lead to Mass Assignment. Either guessing objects properties, exploring other API endpoints, reading the documentation, or providing additional object properties in request payloads, allows attackers to modify object properties they are not supposed to.
API7:2019 – Security Misconfiguration	Security misconfiguration is commonly a result of unsecure default configurations, incomplete or ad-hoc configurations, open cloud storage, misconfigured HTTP headers, unnecessary HTTP methods, permissive Cross-Origin resource sharing (CORS), and verbose error messages containing sensitive information.
API8:2019 – Injection	Injection flaws, such as SQL, NoSQL, Command Injection, etc., occur when untrusted data is sent to an interpreter as part of a command or query. The attacker's malicious data can trick the interpreter into executing unintended commands or accessing data without proper authorization.
API9:2019 – Improper Assets Management	APIs tend to expose more endpoints than traditional web applications, making proper and updated documentation highly important. Proper hosts and deployed API versions inventory also play an important role to mitigate issues such as deprecated API versions and exposed debug endpoints.
API10:2019 – Insufficient Logging & Monitoring	Insufficient logging and monitoring, coupled with missing or ineffective integration with incident response, allows attackers to further attack systems, maintain persistence, pivot to more systems to tamper with, extract, or destroy data. Most breach studies demonstrate the time to detect a breach is over 200 days, typically detected by external parties rather than internal processes or monitoring.

For more information what we can do for your API topic, visit seeburger.com/platform/api-management-and-eai/