OWASP API Security Top 10 2019

The Ten Most Critical Web Application Security Risks

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FW Foreword

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RISK API Security Risk

The [OWASP Risk Rating Methodology](#) was used to do the risk analysis.

The table below summarizes the terminology associated with the risk score.

Threat Agents	Exploitability	Weakness Prevalence	Weakness Detectability	Technical Impact	Business Impacts
API Specific	Easy: **3**	Widespread **3**	Easy **3**	Severe **3**	Business Specific
	Average: **2**	Common **2**	Average **2**	Moderate **2**	
	Difficult: **1**	Difficult **1**	Difficult **1**	Minor **1**	

Note: This approach does not take the likelihood of the threat agent into account. Nor does it account for any of the various technical details associated with your particular application. Any of these factors could significantly affect the overall likelihood of an attacker finding and exploiting a particular vulnerability. This rating does not take into account the actual impact on your business. Your organization will have to decide how much security risk from applications and APIs the organization is willing to accept given your culture, industry, and regulatory environment. The purpose of the OWASP API Security Top 10 is not to do this risk analysis for you.

T10 OWASP API Security Top 10 - 2019

A1:2019 - Broken Object Level Access Control	APIs tend to expose endpoints that handle object identifiers, creating a wide attack surface Level Access Control issue. Object level authorization checks should be taken in mind in every function that accesses a data source using an input from the user.
A2:2019 - Broken 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 overall security.
A3:2019 - Improper Data Filtering	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 showing it to the user. Without controlling client's state, servers receive more and more filters which can be abused to gain access to sensitive data.
A4:2019 - 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 this can impact the API server performance, leading to Denial of Service (DoS), but also leaves the door open to authentication flaws such as brute force.
A5:2019 - Missing Function/Resource Level Access Control	Complex access control policies with different hierarchies, groups and roles and a not so clear separation between administrative and regular functions tend to lead to authorization flaws. Exploiting these issues, attackers gain access to other users resources and/or administrative functions.
A6:2019 - 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 or reading the documentation, providing additional object properties in request payloads, allow attackers to modify object properties they are not supposed to.
A7:2019 - Security Misconfiguration	Security misconfiguration is commonly a result of insecure 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.
A8:2019 - Injection	Injection flaws, such as SQL, NoSQL, Command Injection, occur when untrusted data is sent to an interpreter as part of a command or query. The attacker's hostile data can trick the interpreter into executing unintended commands or accessing data without proper authorization.
A9:2019 - Improper Assets Management	APIs tend to expose more endpoints than traditional web applications, what makes 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.
A10:2019 - 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 and tamper, extract, or destroy data. Most breach studies show time to detect a breach is over 200 days, typically detected by external parties rather than internal processes or monitoring.

A1:2019 Broken Object Level Access Control

API Specific	Exploitability: 3	Prevalence: 3	Detectability: 2	Technical: 3	Business Specific
Attackers can exploit API endpoints that are vulnerable to broken object access control by manipulating the ID of an object that is sent in the request. This may lead to unauthorized access to sensitive data. This issue is extremely common in API based applications because the server component usually does not fully track the client's state, and instead relies more on parameters like object IDs, that are sent from the client to decide which objects to access.		This has been the most common and impactful attack on APIs. Authorization and access control mechanisms in modern applications are complex and wide-spread. Even if the application implements a proper infrastructure for authorization checks, developers might forget to use these checks before accessing a sensitive object. Access control detection is not typically amenable to automated static or dynamic testing.		Unauthorized access can result in data disclosure to unauthorized parties, data loss, or data manipulation. Unauthorized access to objects can also lead to full account takeover.	

Is The API Vulnerable?

Object access control is a mechanism that is usually implemented at the code level to validate that one user can access only objects that they should have access to.

Every API endpoint that receives an ID of an object and performs any type of action on the object should implement object level access control checks. The checks should validate that the logged-in user does have access to perform the requested action on the requested object.

Failures in the mechanism typically leads to unauthorized information disclosure, modification or destruction of all data.

Example Attack Scenarios

Scenario #1

An e-commerce platform for online stores provides a listing page with the revenue charts for their hosted shops. Inspecting the browser requests, an attacker identifies 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 gets the list of all hosted shop names. With a simple script to iterate over 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 get 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 user account data.

A1:2019 Broken Object Level Access Control

How To Prevent

- Implement a proper access control mechanism that relies on the user policies and hierarchy.
- Prefer not to use an ID that has been sent from the client, but instead use an ID that is stored in the session object when accessing a database record by the record ID.
- Use an access control mechanism to check if the logged in user has access to perform the requested action on the record in every function that uses an input from the client to access a record in the database.
- Prefer to use random and unpredictable values as GUIDs for records' IDs.

References

OWASP

External

- [CWE-284: Improper Access Control](#)
- [CWE-285: Improper Authorization](#)
- [CWE-639: Authorization Bypass Through User-Controlled Key](#)

A2:2019　Broken Authentication

Threat Agents	Attack Vectors	Security Weakness		Impacts
API Specific	Exploitability: 3	Prevalence: 2	Detectability: 2	Technical: 3　Business Specific
Keys are the most popular API authentication mechanism but managing them correctly is not an easy task. Attackers have automatic tools to search for API keys on public repositories or mobile applications.	When authentication is based simply on keys, once the attacker gets access to valid tokens they can perform legitimate API requests. Although access can be logged and monitored, the ability to investigate and identify malicious activity is not a simple task.			The impact greatly depends on access tokens grants and can range from the exposure of sensitive data for a single user to full data access or even control over multiple systems and services.

Is the API Vulnerable?

The API is vulnerable if:

- Authentication only relies on access tokens.

- The same access token is valid for multiple APIs or API versions.

- Access tokens are tracked together with the source code on a version control system or hard-coded in the client.

Example Attack Scenarios

Scenario #1

A mobile application adds smartphone-controlled geolocation, remote start/stop and lock/unlock capabilities to a vehicle with a compatible remote start unit. By reverse engineering the mobile application an attacker finds hard-coded admin credentials which can be used in place of a user's username and password to communicate with the server endpoint for a target user's account. With these credentials the attacker can learn the location of a target as well as gain unauthorized control over the car.

Scenario #2

A company uses private repositories on a web-based hosting service for version control. Access tokens to their internal APIs as well as cloud services are tracked together with the source code and an attacker targeting this company gains control over the private repository. Using the exposed access tokens the attacker not only gets access to sensitive data but also control over some services.

Broken Authentication

How To Prevent

- APIs that have access to sensitive data should use an additional form of authentication in addition to API keys.

- API keys should have restrictions both for the applications (e.g. mobile app, IP address) and the set of APIs they are valid for.

- API keys should be stored on a secure location such as a vault.

- A Configuration Management (CM) tool should be used and a clear configuration management process should be defined.

References

OWASP

- [OWASP Key Management Cheat Sheet](#)

External

- [CWE-798: Use of Hard-coded Credentials](#)

A3:2019 Improper Data Filtering

Threat Agents	Attack Vectors		Security Weakness		Impacts	
API Specific	Exploitability: 3	Prevalence: 2	Detectability: 2		Technical: 2	Business Specific
Exploitation of improper data filtering is simple, and is usually done by using different clients while sniffing the traffic they produce to analyze the API responses and look for sensitive data exposure that should not be returned to the user.	APIs rely on clients to perform the data filtering. Since APIs are used as data sources, sometimes developers try to implement them in a generic way without thinking about the sensitivity of the exposed data. Automatic tools usually can't detect this type of vulnerability because it's hard to differentiate between legitimate data returned from the API and sensitive data that should not be returned without a deep understanding of the application.				Improper Data Filtering commonly leads to exposure of sensitive data.	

Is the API Vulnerable?

There are two types of Improper Data Filtering:

- **Client Side Data Filtering**: The API returns sensitive data to the client by design. This data is usually filtered on the client side before being presented to the user. An attacker can easily sniff the traffic and see the sensitive data.

- **Filter Manipulation**: the API performs data filtering in an unsafe manner based on filters from the client. An attacker can send malicious filters causing the API to return sensitive data they should not be exposed to.

Example Attack Scenarios

Scenario #1

The mobile team uses the `/api/articles/{articleId}/comments/{commentId}` endpoint in the articles view to render comments metadata. Sniffing the mobile application traffic an attacker finds out that other sensitive data related to comment's author, is also returned. The endpoint implementation uses a generic `toJSON()` method on the `User` model, which contains PII, to serialize the object.

Scenario #2

An open source team chat solution provides the endpoint `/api/v1/users.list` which supports two parameters: `query` and `fields`. Using a regular user account and manipulating both parameters an attacker can enumerate admin accounts, exposing sensitive information such as the password reset token: `GET /api/v1/users.list?query={"roles": {$in:"admin"}}&fields={"services.password.reset":1, "username":1", "email.0":1}`. Via password reset, the attacker can takeover one of the admin accounts.

A3:2019 Improper Data Filtering

How To Prevent

- Never rely on the client side to perform sensitive data filtering.

- Review the responses from the API to make sure they contain only legitimate data.

- Be careful when performing data filtering based on filters from the client.

References

OWASP

External

A4:2019 Lack of Resources & Rate Limiting

	Threat Agents	Attack Vectors	Security Weakness		Impacts	
API Specific	Exploitability: 2	Prevalence: 3	Detectability: 3	Technical: 2	Business Specific
	Exploitation requires simple API requests. No authentication is required. Multiple concurrent requests can be performed from a single local computer or by using cloud computing resources.	It's common to find APIs that do not implement rate limiting or APIs where limits are not properly set.		Exploitation may lead to DoS, making the API unresponsive or even unavailable.	

Is the API Vulnerable?

API requests consume resources such as network, CPU, memory and storage and the amount of resources required to satisfy a request greatly depends on the user input and endpoint business logic. Also consider that requests from multiple API clients compete for resources. An API is vulnerable if at least one of the following limits is missing or set inappropriately (i.e. too low/high)

- Execution timeouts
- Max allocable memory
- Number of file descriptors
- Number of processes
- Request payload size (e.g. uploads)
- Number of requests per client/resource

Example Attack Scenarios

Scenario #1

An attacker uploads a large image by issuing a POST request to `/api/v1/images`. When the upload is complete, the API creates multiple thumbnails with different sizes. Due to the size of the uploaded image, available memory is exhausted during the creation of thumbnails and the API becomes unresponsive.

Scenario #2

An attacker starts the password recovery workflow by issuing a POST request to `/api/system/verification-codes` and by providing the username in the request body. Next an SMS token with 6 digits is sent to the victim's phone. Because the API does not implement a rate limiting policy the attacker can test all possible combinations using a multi-thread script, against the `/api/system/verification-codes/{smsToken}` endpoint to discover the right token within a few minutes.

A4:2019 Lack of Resources & Rate Limiting

How To Prevent

- Docker makes it easy to limit <u>memory</u>, <u>CPU</u>, <u>number of restarts</u>, <u>file descriptors and processes</u>.

- Implement a limit on how often a client can call the API within a defined timeframe.

- Notify the client when the limit is exceeded by providing the limit number and the time at which the limit will be reset.

References

OWASP

- <u>Blocking Brute Force Attacks</u>
- <u>Docker Cheat Sheet - Limit resources (memory, CPU, file descriptors, processes, restarts)</u>
- <u>REST Assessment Cheat Sheet</u>

External

- <u>CWE-307: Improper Restriction of Excessive Authentication Attempts</u>
- <u>CWE-770: Allocation of Resources Without Limits or Throttling</u>
- *"Rate Limiting (Throttling)"* - <u>Security Strategies for Microservices-based Application Systems</u>, NIST

A5:2019 Missing Function/Resources Level Access Control

Threat Agents	Attack Vectors	Security Weakness		Impacts
API Specific	**Exploitability: 3**	**Prevalence: 2**	**Detectability: 1**	**Technical: 2** Business Specific
Exploitation requires the attacker to send legitimate API calls to the API endpoint they should not have access to. These endpoints might be exposed to anonymous users or regular, non-privileged users. It is easier to discover these flaws in APIs since APIs are more structured, and the way to access certain functions is more predictable (e.g. replacing the HTTP method from `GET` to `PUT`, or changing the "users" string in the URL to "admins")	Access control checks for a function or resource are usually managed via configuration, and sometimes at the code level. Implementing proper checks can be a confusing task since modern applications can contain many types of roles or groups and complex user hierarchy (e.g. sub-users, users with more than one role)			Such flaws allow attackers to access unauthorized functionality. Administrative functions are key targets for this type of attack

Is the API Vulnerable?

The best way to find missing function or resource level access control is to perform deep analysis of the authorization mechanism while keeping in mind the user hierarchy, different roles or groups in the application, and asking the following questions:

- Can a regular user access administrative endpoints?

- Can a user perform sensitive actions (e.g. creation, modification or erasure) that they should not have access to by simply changing the HTTP method (e.g. from `GET` to `DELETE`)?

- Can a user from group X access a function that should be exposed only to users from group Y by simply guessing the endpoint URL and parameters (e.g. `/api/v1/users/export_all`)?

Don't assume that an API endpoint is regular or administrative only based on the URL path.

While developers might choose to expose most of the administrative endpoints under a specific relative path, like `api/admins`, it's very common to find these administrative endpoints under other relative paths together with regular endpoints, like `api/users`.

Example Attack Scenarios

Scenario #1

During the registration process to an application that allows only invited users to join, the mobile application triggers an API call to `GET /api/invites/{invite_guid}`. The response contains a JSON with details about the invite including the user's role and the user's email.

An attacker duplicated the request and manipulated the HTTP method and endpoint to `POST /api/invites/new`. This endpoint should only be accessed by administrators using the admin console which does not implement function level access control checks.

The attacker exploits the issue and sends himself an invite to create an admin account:

```
POST /api/invites/new
{"email":"hugo@malicious.com","role":"admin"}
```

Missing Function/Resources Level Access Control

Scenario #2

An API contains an endpoint that should be exposed only administrators - `GET /api/admin/v1/users/all`. This endpoint returns the details of all the users on the application and does not implement function level access control 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.

How To Prevent

Your application should have a consistent and easy to analyze authorization module that is invoked from all your business functions. Frequently, such protection is provided by one or more components external to the application code.

- The enforcement mechanism(s) should deny all access by default, requiring explicit grants to specific roles for access to every function.

- Review your API endpoints against function level access control flaws, while keeping in mind the business logic of the application and groups hierarchy.

- Make sure that all of your administrative controllers inherit from an administrative abstract controller that implements access control checks based on the user's group/role.

- Make sure that administrative functions inside a regular controller implements access control checks based on the user's group and role.
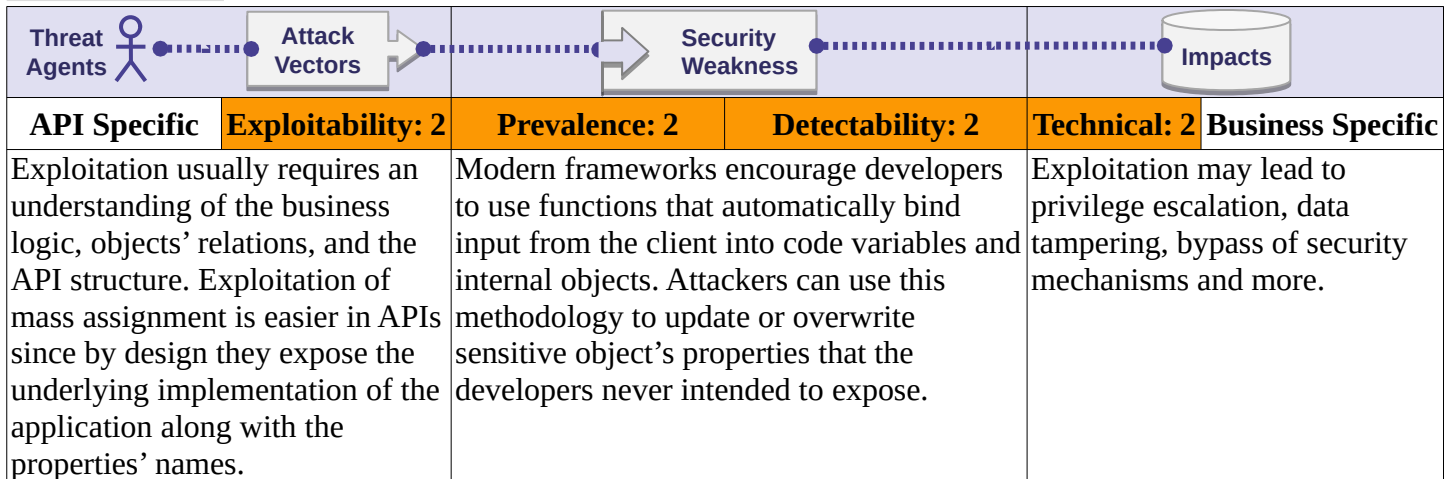
References

OWASP

- [OWASP Article on Forced Browsing](#)
- [OWASP Top 10 2013-A7-Missing Function Level Access Control](#)
- [OWASP Development Guide: Chapter on Authorization](#)

External

- [CWE-285: Improper Authorization](#)

A6:2019 Mass Assignment

Threat Agents	Attack Vectors	Security Weakness		Impacts
API Specific	**Exploitability: 2**	**Prevalence: 2**	**Detectability: 2**	**Technical: 2**	**Business Specific**
Exploitation usually requires an understanding of the business logic, objects' relations, and the API structure. Exploitation of mass assignment is easier in APIs since by design they expose the underlying implementation of the application along with the properties' names.	Modern frameworks encourage developers to use functions that automatically bind input from the client into code variables and internal objects. Attackers can use this methodology to update or overwrite sensitive object's properties that the developers never intended to expose.			Exploitation may lead to privilege escalation, data tampering, bypass of security mechanisms and more.

Is the API Vulnerable?

Objects in modern applications might contain many properties. Some of these properties should be updated directly by the client (e.g. `user.first_name` or `user.address`) and some of them should not (e.g. `user.is_vip` flag)

An API endpoint is vulnerable if it automatically converts client parameters into internal object properties without considering the sensitivity and the exposure level of these properties. This could allow an attacker to update object properties that they should not have access to.

Examples for sensitive properties:

- **Permission-related properties**: `user.is_admin`, `user.is_vip` should only be set by admins.

- **Process-dependent properties**: `user.cash` should only be set internally after payment verification.

- **Internal properties**: `article.created_time` should only be set internally by the application.

Example Attack Scenarios

Scenario #1

A ride sharing application provides a user the option to edit basic information for their profile. During this process an API call is sent to `PUT /api/v1/users/me` with the following legitimate JSON object:

```
{"user_name":"inons","age":24}
```

The request `GET /api/v1/users/me` includes an additional credit_balance property:

```
{"user_name":"inons","age":24,"credit_balance":10}.
```

The attacker replays the first request with the following payload:

```
{"user_name":"attacker","age":60,"credit_balance":99999}
```

Since the endpoint is vulnerable to mass assignment, the attacker receives credits without paying.

A6:2019 Mass Assignment

Scenario #2

A video sharing portal allows users to upload content and download content in different formats. An attacker who explores the API found that the endpoint `GET /api/v1/videos/{video_id}/meta_data` returns a JSON object with the video's properties. One of the properties is `"mp4_conversion_params":"-v codec h264":` which indicates that the application uses a shell command to convert the video.

The attacker also found the endpoint `POST /api/v1/videos/new` is vulnerable to mass assignment and allows the client to set any property of the video object. The attacker sets a malicious value: `"mp4_conversion_params":"-v codec h264 && format C:/".` This value will cause a shell command injection once the attacker downloads the video as MP4.

How To Prevent

- If possible, avoid using functions that automatically bind a client's input into code variables or internal objects.

- Whitelist only the properties that should be updated by the client.

- Use built-in features to blacklist properties that should not be accessed by clients.

References

OWASP

External

- [CWE-915: Improperly Controlled Modification of Dynamically-Determined Object Attributes](#)

A7:2019 Security Misconfiguration

API Specific	Exploitability: 3	Prevalence: 3	Detectability: 3	Technical: 2	Business Specific
Attackers will often attempt to find unpatched flaws, common endpoints or unprotected files and directories to gain unauthorized access or knowledge of the system.		Security misconfiguration can happen at any level of the API stack from the network to the application level. Automated tools are available to detect and exploit misconfigurations such as unnecessary services or legacy options.		Security misconfigurations can expose not only sensitive user data but also system details what may lead to full server compromise.	

Is the API Vulnerable?

The API might be vulnerable if:

- Appropriate security hardening is missing across any part of the application stack or if it has improperly configured permissions on cloud services.

- The latest security patches are missing or the systems are out of date.

- Unnecessary features are enabled (e.g. HTTP verbs).

- Transport Layer Security (TLS) is missing.

- Security directives are not sent to clients (e.g. Security Headers).

- A Cross-Origin Resource Sharing (CORS) policy is missing or improperly set.

- Error messages include stack traces or other sensitive information is exposed.

Example Attack Scenarios

Scenario #1

An attacker finds the `.bash_history` file under the root of the server which contains commands used by the DevOps team to access the API:

```
$ curl -X GET 'https://api.server/endpoint/' -H 'authorization: Basic Zm9vOmJhcg=='
```

An attacker could also find new endpoints on the API that are used only by the DevOps team and not documented.

Scenario #2

To target a specific service, an attacker uses a popular search engine to search for computers directly accessible from the Internet. The attacker found a host running a popular database management system listening on the default port. The host was using the default configuration which has authentication disabled by default and the attacker gained access to millions of records with PII, personal preferences and authentication data.

Scenario #3

Inspecting traffic of a mobile application an attacker finds out that not all HTTP traffic is performed on a secure protocol (i.e TLS). The attacker finds this to be true specifically for the download of profile images. As user interaction is binary, despite the fact that API traffic is performed on a secure protocol, the attacker finds a pattern on API responses size which he uses to track user preferences over the rendered content (profile images).

How To Prevent

The API lifecycle should include:

- A repeatable hardening process leading to fast and easy deployment of a properly locked down environment.

- A task to review and update configurations across the entire API stack. The review should include API components and cloud services (e.g. S3 bucket permissions).

- A secure communication channel for all API interactions access to static assets (e.g. images).

- An automated process to continuously assess the effectiveness of the configuration and settings in all environments.

References

OWASP

- [OWASP Secure Headers Project](#)

- [OWASP Testing Guide: Configuration Management](#)

- [OWASP Testing Guide: Testing for Error Codes](#)

External

- [CWE-2: Environmental Security Flaws](#)

- [CWE-16: Configuration](#)

- [CWE-388: Error Handling](#)

- [Guide to General Server Security](#), NIST

- [Let's Encrypt: a free, automated, and open Certificate Authority](#)

A8:2019 Injection

Threat Agents	Attack Vectors		Security Weakness		Impacts	
API Specific	Exploitability: 3	Prevalence: 2		Detectability: 3	Technical: 3	Business Specific
Attackers will feed the API with hostile data through whatever injection vectors are available (e.g. direct input, parameters, integrated services, etc.) expecting it to e sent to an interpreter.	Injection flaws are very common and often found in SQL, LDAP or NoSQL queries, OS commands, XML parsers and ORM. These flaws are easy to discover when reviewing the source code. Attackers can use scanners and fuzzers.				Injection can lead to information disclosure and data loss. It may also lead to DoS or complete host takeover.	

Is the API Vulnerable?

The API is vulnerable to injection flaws if:

- Client-supplied data is not validated, filtered or sanitized by the API.

- Client-supplied data is directly used or concatenated to SQL/NoSQL/LDAP queries, OS commands, XML parsers. and Object Relational Mapping (ORM)/Object Document Mapper (ODM).

- Data coming from external systems (e.g. integrated systems) is not validated, filtered or sanitized by the API.

Example Attack Scenarios

Scenario #1

Inspecting the web browser network traffic an attacker identifies the following API request responsible to start the recovery password workflow:

```
POST /api/accounts/recovery
{"username": "john@somehost.com"}
```

The attacker replays the request with a different payload

```
POST /api/account/recovery
{"email": "john@somehost.com';WAITFOR DELAY '0:0:5'--"}
```

This time the response took ~5 seconds confirming the API is vulnerable to SQL injection. Exploiting this vulnerability the attacker was able to gain unauthorized access to the system.

Scenario #2

Firmware of a parental control device provides the endpoint `/api/CONFIG/restore` which expects an appId to be sent as a multipart parameter. Using a decompiler an attacker finds out that the appId is passed directly into a system call without any sanitization:

```
snprintf(cmd, 128, "%srestore_backup.sh /tmp/postfile.bin %s %d",
        "/mnt/shares/usr/bin/scripts/", appid, 66);
system(cmd);
```

The following command allows the attacker to shutdown any device with the same vulnerable firmware:

```
$ curl -k "https://${deviceIP}:4567/api/CONFIG/restore" -F
'appid=$(/etc/pod/power_down.sh)'
```

A8:2019 Injection

How To Prevent

Preventing injection requires keeping data separate from commands and queries.

- Perform data validation using a single, trustworthy, actively maintained library.

- Validate, filter and sanitize all client-provided data or other data coming from integrated systems.

- Special characters should be escaped using the specific syntax for the target interpreter.

- Prefer a safe API which provides a parameterized interface.

- Always limit the number of returned records to prevent mass disclosure in case of injection.

References

OWASP

- [OWASP Injection Flaws](#)

- [SQL Injection](#)

- [NoSQL Injection Fun with Objects and Arrays](#)

- [Command Injection](#)

External

- [CWE-77: Command Injection](#)

- [CWE-89: SQL Injection](#)

- [HOW TO: Command Injection, HackerOne](#)

A9:2019 Improper Assets Management

Threat Agents	Attack Vectors	Security Weakness	Impacts
API Specific	Exploitability: 3	Prevalence: 3 Detectability: 2	Technical: 2 Business Specific
Old API versions are usually unpatched and are an easy way to compromise systems without having to fight state of the art security mechanisms that might be in place to protect the most recent API versions.	Outdated documentation makes it more difficult to find and/or fix vulnerabilities. Lack of assets inventory and retire strategies leads to running unpatched systems and leakage of sensitive data. It's common to find unnecessarily exposed API hosts because of modern concepts like microservices, which make applications easy to deploy and independent (e.g. cloud computing, k8s)		Attackers may gain access to sensitive data or even takeover the server through old, unpatched API versions connected to the same database.

Is the API Vulnerable?

An API is vulnerable if:

- The purpose of an API host is unclear, and there are no explicit answers to the following questions:
    - Which environment is the API running in (e.g. production, staging, test, development)?
    - Who should have network access to the API (e.g. public, internal, partners)?
    - Which API version is running?
- There is no documentation or the existing documentation is not updated.
- There is no retirement plan for each API version.
- Hosts inventory is missing or outdated.
- Old or previous API versions are running unpatched.

Example Attack Scenarios

Scenario #1

After redesigning their applications, a local search service left an old API version (`api.someservice.com/v1`) running, unprotected and with access to the user database. While targeting one of the latest released applications an attacker found the API address (`api.someservice.com/v2`). Replacing `v2` with `v1` in the URL gave the attacker access to the old, unprotected API, exposing the personal identifiable information (PII) of over 100 Million user.

Scenario #2

A social network implemented a rate-limiting mechanism that blocks attackers from using brute-force to guess reset password tokens. This mechanism wasn't implemented as part of the API code itself, but in a separate component between the client and the and the official API (`www.socialnetwork.com`). A researcher found a beta API host (`www.mbasic.beta.socialnetwork.com`) that runs the same API, including the reset password mechanism, but the rate limiting mechanism was not in place. The researcher was able to reset the password of any user by using a simple brute-force to guess the 6 digits token.

A9:2019 Improper Assets Management

How To Prevent

- Inventory all API hosts and document important aspects of each one of them, focusing on the API environment (e.g. production, staging, test, development), who should have network access to the host (e.g. public, internal, partners) and the API version.

- Document all aspects of your API such as authentication, errors, redirects, rate limiting, cross-origin resource sharing (CORS) policy and endpoints, including their parameters, requests and responses.

- Generate documentation automatically by adopting open standards. Include the documentation build in your CI/CD pipeline.

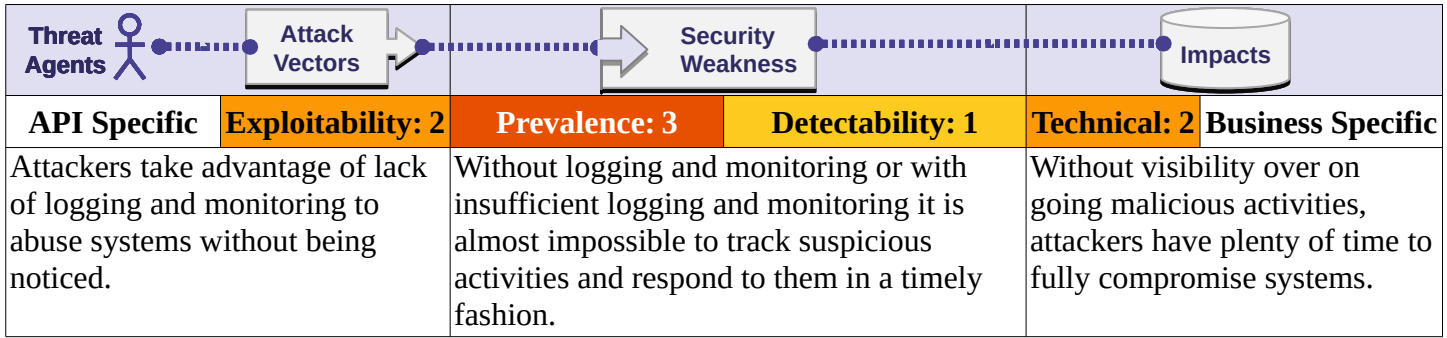- Make API documentation available to those authorized to use the API.

References

OWASP

External

- [CWE-1059: Incomplete Documentation](#)
- [OpenAPI Initiative](#)

A10:2019 Insufficient Logging & Monitoring

	Threat Agents	Attack Vectors	Security Weakness		Impacts	
API Specific	Exploitability: 2	Prevalence: 3	Detectability: 1	Technical: 2	Business Specific
Attackers take advantage of lack of logging and monitoring to abuse systems without being noticed.		Without logging and monitoring or with insufficient logging and monitoring it is almost impossible to track suspicious activities and respond to them in a timely fashion.		Without visibility over on going malicious activities, attackers have plenty of time to fully compromise systems.	

Is the API Vulnerable?

The API is vulnerable if:

- It does not produce any logs, tha logging level is not set correctly or log messages do not include enough detail.

- Log integrity is not guaranteed (e.g. Log Injection).

- Logs are not continuously monitored.

- API infrastructure is not continuously monitored.

Example Attack Scenarios

Scenario #1

Access keys of an administrative API leaked on a public repository. The repository owner was notified by email about the potential leak but took more than 48 hours to act upon the incident and access keys exposure may have allowed access to sensitive data. Due to insufficient logging the company is not able to assess what data was accessed by malicious actors.

Scenario #2

A video-sharing platform was hit by a "large-scale" credential stuffing attack. Despite failed logins being logged, no alerts were triggered during the timespan of the attack. As a reaction to user complaints, API logs were analysed and the attack was detected. The company had to make a public announcement asking users to reset their passwords and report the incident to regulatory authorities.

A10:2019 Insufficient Logging & Monitoring

How To Prevent

- Log all failed authentication attempts, denied access and input validation errors.

- Logs should be written using a format suited to be consumed by a log management solution and should include enough detail to identify the malicious actor.

- Logs should be handled as sensitive data and their integrity should be guaranteed at rest and transit.

- Configure a monitoring system to continuously monitor infrastructure, network and the API functioning.

- Use a Security Information and Event Management (SIEM) system to aggregate and manage logs from all components of the API stack and hosts.

- Configure custom dashboards and alerts, enabling suspicious activities to be detected and responded earlier.

References

OWASP

- [OWASP Logging Cheat Sheet](#)

- [OWASP Proactive Controls: Implement Logging and Intrusion Detection](#)

- [OWASP Application Security Verification Standard: V7: Error Handling and Logging Verification Requirements](#)

External

- [CWE-223: Omission of Security-relevant Information](#)

- [CWE-778: Insufficient Logging](#)

+D **What's Next for Developers**

+ACK **Ackownledgment**