



# Open Retailing API Implementation Guide: Security

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## Document Summary

This document describes the Open Retailing (fuel retailing and convenience store) API implementation guidelines for security.

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This document was reviewed and approved by the Joint IFSF and Conexus Application Programming Interface Work Group and the Technical Advisory Committee within Conexus.

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28 July 2019	V1.0	John Carrier, IFSF	Updated to v1.0
14 July 2019	Final Draft V1.0	Linda Toth, Conexus	Accepted all changes and cleaned up formatting. Added OWASP to references.
9 July 2019	Vo.4.1	David Ezell, Conexus	Added changes from Joint API Call on 2019-07-09
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# 1 Introduction

This document is part of a set of standards and guides for implementing Open Retailing JSON messages using the RESTful web services. The rationale for using HTTPS and RESTful web services is found in a companion document, Open Retailing API Implementation Guide: Transport Alternatives, which describes the possible alternative transport mechanisms in a priority sequence. This document describes the security aspects of those transport technologies. Security is in a separate document since it is more frequently updated alongside industry best practice. This guide helps ensure that implementations interoperate with minimal development and configuration by reducing choices implementers have to make.

Please note in this document the key words, “MUST”, “MUST NOT”, “REQUIRED”, “SHALL”, “SHALL NOT”, “SHOULD”, “SHOULD NOT”, “RECOMMENDED”, “MAY” and “OPTIONAL” in this document are to be interpreted as described in the IETF RFC2119 to indicate requirement levels. As defined in the IETF RFC2119, these words are shown in capital letters.

All implementations, irrespective of data sensitivity, **MUST** be HTTPS. HTTP **MAY** be used during development and initial testing stages. This document supercedes IFSF Standard Forecourt Protocol Part II-3 IFSF Communications over HTTP Rest for API implementations.

## 1.1 Audience

The intended audiences of this document include, non-exhaustively:

- Architects and developers designing, developing, or documenting RESTful Web Services; and
- Standards architects and analysts developing specifications that make use of Open Retailing REST based APIs.

## 2 Security Considerations

Note: Enabling the use of proxies and firewalls is beyond the scope of this document, other than configurations requiring headers or schemes that are declared invalid in this document.

### 2.1 Network Security

#### 2.1.1 Use of TLS

NIST provides extensive guidelines for the selection, configuration, and use of Transport Layer Security (TLS) Implementations. While key parts are extracted below, the full set

of guidelines, Special Publication 800-52, should be referenced when developing implementations.

TLS **MUST** be supported by all parties, although it **MAY** be disabled during testing. Whenever TLS is active, the following rules **MUST** be observed:

- TLS version: servers and clients **MUST** support TLS 1.2. SSL 2.0, SSL 3.0, TLS 1.0 and TLS 1.1 **MUST NOT** be used and are forbidden. TLS 1.3 is currently in draft, so it is not considered;
- Key exchange: servers and clients **MUST** support DHE-RSA (forward secrecy), which is part of both TLS 1.2 and TLS 1.3 draft;
- Block Ciphers: servers and clients **MUST** support AES-256 CBC. DES, 3DES, AES-128 and AES192 **MUST NOT** be used and are forbidden;
- Data integrity: servers and clients **MUST** support HMAC-SHA256/384. HMAC-MD5 and HMAC-SHA1 **MUST NOT** be used and are forbidden;
- Vendors are allowed to support other TLS, key exchange, block ciphers and data integrity algorithms. These are **OPTIONAL**, but may result in a non interoperable implementation;
- Certificates signed using MD5 or SHA1 **MUST NOT** be trusted. All vendors **MUST** support certificates signed using SHA2. Self-signed certificates are allowed; and
- Vendors **MUST** provide mechanisms for authorized users and technicians to disable security algorithms in order to keep up with security industry recommendations. As reference for vulnerability publications, please refer to the NIST national vulnerability database and/or the Mitre common vulnerabilities and exposures.

### 2.1.2 Certificate Management

Each equipment manufacturer **SHOULD** provide a documented means of loading certificates to connect devices to other applications. In addition, it **SHOULD** provide a certificate for connecting applications. The following functions must be covered:

- Adding a root or intermediate certificate to connect to the certificate store;
- Revoking a certificate; and
- Connecting to one or more external certificate providers. This will give a company the possibility to centrally manage certificates.

Implementation details for these functionalities are responsibility of each equipment manufacturer but **SHOULD** be documented for certification.

The client systems **MUST** support both Online Certificate Status Protocol (OCSP) and Certificate Revocation List (CRL) for online certificate verification. In case of the CRL

repository or the OCSP server not being available, the implementer **SHOULD** be capable of determining if a soft fail (assume the certificate has not being revoked) is allowed or not.

OCSP and/or a hard fail must be enforced if:

- There is a legal obligation to enforce the certificate and certificate chain; or
- The CRL grows indiscriminately or there is no one to maintain it.

At the time of writing, CRLSet as proposed by Google for CRL distribution and offline certificate verification is still not mature enough to be included in this standard.

### 2.1.3 Threat Model

The OWASP (Open Web Application Security Project) provides a good outline for a viable threat model:

- **Assessment Scope** - The first step is always to understand what's on the line. Identifying tangible assets, like databases of information or sensitive files is usually easy. Understanding the capabilities provided by the application and valuing them is more difficult. Less concrete things, such as reputation and goodwill are the most difficult to measure, but are often the most critical.
- **Identify Threat Agents and possible Attacks** - A key part of the threat model is a characterization of the different groups of people who might be able to attack your application. These groups should include insiders and outsiders, performing both inadvertent mistakes and malicious attacks.
- **Understand existing Countermeasures** - The model must include the existing countermeasures
- **Identify exploitable Vulnerabilities** - Once you have an understanding of the security in the application, you can then analyze for new vulnerabilities. The search is for vulnerabilities that connect the possible attacks you've identified to the negative consequences you've identified.
- **Prioritized identified risks** - Prioritization is everything in threat modeling, as there are always lots of risks that simply don't rate any attention. For each threat, you estimate a number of likelihood and impact factors to determine an overall risk or severity level.
- **Identify Countermeasures to reduce threat** - The last step is to identify countermeasures to reduce the risk to acceptable levels.



## 2.2 Application Authentication and Authorization

Authentication and authorization methods **SHOULD** be supported for every Open Retailing compliant API. Options are:

- Username and Password;
- API keys; or
- OAuth 2.0.

The **RECOMMENDED** choice is OAUTH2.0 whenever possible. The implementing parties **MUST NOT** disable all authentication methods, hence providing access with no authentication. This is true even when the implementer deems the infrastructure is already secure, or if access authentication and authorization is delegated to an external application.

Any Open Retailing compliant API **MAY** implement OAuth 2.0 for delegation of authentication functions, which allows for central management of API access. . Although not mandatory, applications connecting to a REST API are **RECOMMENDED** to support API keys authentication over OAuth 2.0 architecture, as APIs security can be enhanced to support OAuth security through third party application packages.

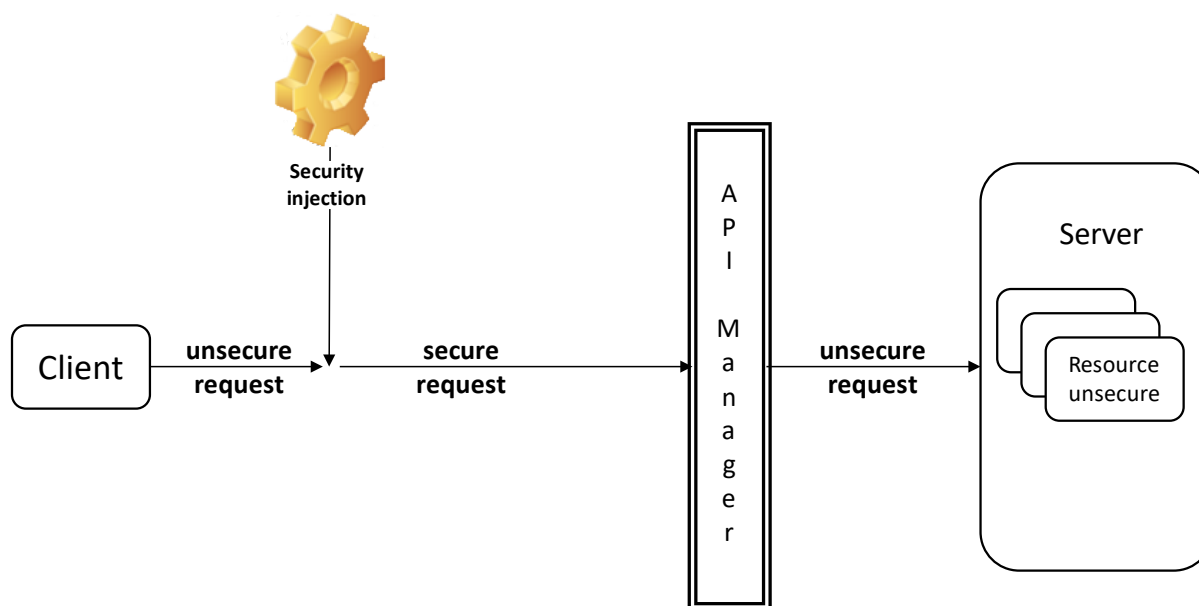
Note: Use of HTTP digest access authentication is not recommended because TLS provides higher levels of security, as well as better encryption keys management processes.

To provide a higher level of security and implementing advanced security features while keeping security implementation and management processes unified for all implemented APIs, the implementer **MAY** deploy a central security management application to decouple authentication from APIs.

There are both open source and enterprise grade available API manager software applications that provide security services, including but not limited to:

- OAuth security;
- Token based security;
- End to end encryption with TLS;
- Rate limiting to control traffic;
- Centralized administration;
- Monitoring tools; and
- Revocation policies.

An API manager software application adds security to an unsecured API by exposing new secured endpoints to API clients and, once properly authorized, forwarding the request to the unsecured API, as depicted in the figure below:



**Figure 1: Using API Managers to Secure Resources**

Note: Although an API manager can add security to an unsecured API, injection of security into the client will still be required.

Implementing advanced security features within APIs is not recommended because of:

- Software development complexity;
  - Cost of development
  - Time of implementation
  - Need of specialized development professionals
  - High testing complexity
  - High certification complexity
- Cost of Support over a large variety of systems; and
- Permanent need to update security to keep up to date throughout time.
  - Security algorithms are permanently deprecated due to detected vulnerabilities (e.g., DES)

### 2.2.1 Using Username and Password to Authenticate Users

To request access using a username and password combination, the client application must include in the header a string containing username and password separated by a colon encoded in base64. Note: Base64 encoding will not provide any level of encryption; encryption can be achieved by using TLS 1.2.

### Submitted request:

```
POST /fdc/v2/sites
Host: api.openretailing.org
Authorization: Basic SUZTRkNsaWVudDpwbGVhc2VHaXZlTWVBY2Nlc3M=
Content-Type: charset=UTF-8
Body Payload
```

## 2.2.2 Using API Keys to Authenticate Access

To request access using an API KEY, the client application **MUST** include in the header an API key value string. Base64 encoding is not required in this case, as API keys are designed not to require encoding. Encryption can be achieved by using TLS 1.2.

**Note:** Moving the API Key into the `Authentication` header allows much more efficient caching. The HTTP Specification (IETF RFC 7234) states that:

*"A shared cache MUST NOT use a cached response to a request with an Authorization header field (Section 4.2 of [RFC7235]) to satisfy any subsequent request unless a cache directive that allows such responses to be stored is present in the response".*

This avoids cache servers sending the same response to other applications, unless the response contains the following directive: `Cache-Control: public`, enforcing cache servers to cache the response for further API clients.

### Submitted request:

```
POST /fdc/v2/sites
Host: api.openretailing.org
Authorization: apikey ClientAbc123
Content-Type: charset=UTF-8
Body Payload
```

## 2.2.3 Using OAuth2.0 to Authenticate API Keys

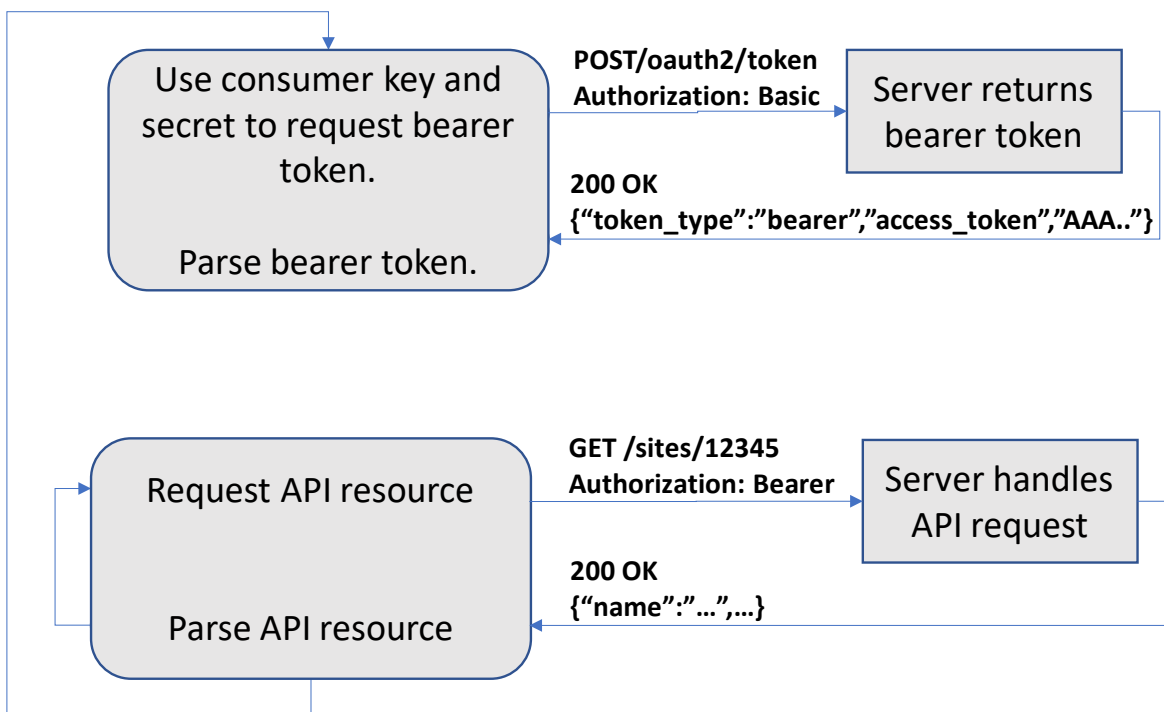
API Keys over OAuth2.0 can be used to authenticate communications between devices. OAuth2.0 is the Open Retailing **RECOMMENDED** authentication method.

The API key performs applicationonly authentication. Implementers of API key authentication should keep in mind the following:

- Tokens are passwords: The consumer key & secret, bearer token credentials, and the bearer token itself grant access to make requests on behalf of an application. These values **SHOULD** be considered as sensitive as passwords and **MUST**

**NOT** be shared or distributed to untrusted parties. The implementer **MUST** define proper ways to store and distribute these tokens. TLS is mandatory during token negotiation: This authentication method is only secure if TLS is used. Therefore, all requests (to both obtain and use the tokens) **MUST** use HTTPS endpoints.

- No user context: When issuing requests using application-only auth, there is no concept of a “current user.”
- The application-only authentication flow follows these steps:
  1. An application encodes its consumer key and secret into a specially encoded set of credentials.
  2. An application makes a request to the POST oauth2 / token endpoint to exchange these credentials for a bearer token.
  3. When accessing the REST API, the application uses the bearer token to authenticate.
  4. The server manages access to the corresponding entity and verb depending on the token received.



**Figure 2: Application-only authentication flow**

### 2.2.3.1 Encoding Consumer Key and Secret

The steps to encode an application’s consumer key and secret into a set of credentials to obtain a bearer token are:

- URL encode (refer to IETF RFC 1738) the consumer key and the consumer secret. Note that at the time of writing, this will not actually change the consumer key

and secret, but this step should still be performed in case the format of those values changes in the future.

- Create the bearer token credentials by concatenating the encoded consumer key, a colon character “:”, and the encoded consumer secret into a single string.
- Base64 encode the string from the previous step.

Below are example values showing the result of this algorithm.

RFC 1738 encoded consumer key	xvz1evFS4wEEPTGEFPHBog
RFC 1738 encoded consumer secret	L8qq9PZyRg6ieKGEKhZolGCovJWLw8iEJ88DRdyOg
Bearer token credentials	xvz1evFS4wEEPTGEFPHBog:L8qq9PZyRg6ieKGEKhZolGCovJWLw8iEJ88DRdyOg
Base64 encoded bearer token credentials	eHZ6MWV2RlMod0VFUFRHRUZQSEJvZzpMOHFxOVBaeVJnNmllSodFS2hab2xHQzB2SldMdzhpRUo4OERSZHlPZw==

### 2.2.3.2 Obtain a Bearer Token

The value calculated in previous step **MUST** be exchanged for a bearer token by issuing a request to POST `oauth2 / token`:

- The request **MUST** be an HTTPS POST request.
- The request **MUST** include an `Authorization` header with the value of `Basic` along with the base64 encoded bearer token credential.
- The request **MUST** include a `Content-Type` header with the value of `application/x-www-form-urlencoded; charset=UTF-8`.
- The body of the request **MUST** be `grant_type=client_credentials`.

#### Example request (Authorization header has been wrapped):

```
POST / fdc/v2/oauth2/token HTTPS/1.1
Host: api.openretailing.org
Authorization: Basic eHZ6MWV2RlMod0VFUFRHRUZQSEJvZzpMOHFxOVBaeVJnNmllSodFS2hab2xHQzB2SldMdzhpRUo4OERSZHlPZw==
Content-Type: application/x-www-form-urlencoded; charset=UTF-8
Content-Length: 29
grant_type=client_credentials
```

If the request format is correct, the server will respond with a JSON-encoded payload:

### Example Response:

```
HTTPS/1.1 200 OK
Status: 200 OK
Content-Type: application/json; charset=utf-8
Content-Length: 140

{"token_type":"bearer","access_token":"AAAAAAAAAAAAAAAAAAAAAAAAAAAA
AAAAAAAAAAAA%2FAAAAAAAAAAAAAAAAAAAAAAAAAAAAA%3DAAAAAAAAAAAAAAAAAAAA
AAAAAAAAAAAA"}

```

Applications should verify that the value associated with the `token_type` key of the returned object is `bearer`. The value associated with the `access_token` key is the bearer token itself.

### 2.2.3.3 Authenticate API Requests with a Bearer Token

The bearer token **MAY** be used to issue requests to API endpoints that support application-only authentication. To use the bearer token, construct a normal HTTPS request and include an `Authorization` header with the value of `Bearer` along with the base64 bearer token value obtained earlier. Signing is not required.

#### Example request (Authorization header has been wrapped):

```
GET /fdc/v2/sites/country=UK?count=100&limit=10 HTTP/1.1
Host: api.openretailing.org
Authorization: Bearer
AAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA%2FAAAAAAAA
AAAAAAAAAAAA%3DAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA
Accept-Encoding: gzip

```

## 3 Appendices

### A. References

#### A.1 Normative References

**CA/Browser Forum: Baseline Requirements Certificate Policy for the Issuance and Management of Publicly-Trusted Certificates:**

[https://cabforum.org/wp-content/uploads/Baseline\\_Requirements\\_V1\\_3\\_1.pdf](https://cabforum.org/wp-content/uploads/Baseline_Requirements_V1_3_1.pdf)

**Open Retailing API Implementation Guide - Transport Alternatives:**

<https://www.conexus.org> OR <https://www.ifsf.org>

**IETF RFC 1738 Uniform Resource Locators (URL):**

<https://www.ietf.org/rfc/rfc1738.txt>

**IETF RFC 2119 Key words for use in RFCs to Indicate Requirement Levels:**

<https://www.ietf.org/rfc/rfc2119.txt>

**IETF RFC 4169 HTTP Digest Authentication Using Authentication and Key Agreement (AKA) Version-2:**

<https://www.ietf.org/rfc/rfc4169.txt>

**IETF RFC 7234 HTTP/1.1: Caching:**

<https://www.ietf.org/rfc/rfc7234.txt>

**Mitre: Common Vulnerabilities and Exposures:**

<https://cve.mitre.org/>

**NIST National vulnerability database:**

<https://nvd.nist.gov/>

**NIST Special Publication 800-154, Guide to Data-Centric System Threat Modeling:**

<https://csrc.nist.gov/publications/detail/sp/800-154/draft>

**NIST Special Publication 800-52, Guidelines for the Selection, Configuration, and Use of TLS Implementations:**

<https://csrc.nist.gov/publications/detail/sp/800-52/rev-1/final>

**NSA Guidelines for Implementation of REST:**

<https://apps.nsa.gov/iaarchive/library/ia-guidance/security-configuration/applications/guidelines-for-implementation-of-rest.cfm>

**OWASP (Open Web Application Security Project):**

[https://www.owasp.org/index.php/Category:Threat\\_Modeling](https://www.owasp.org/index.php/Category:Threat_Modeling)

#### A.2 Non-Normative References

None

## B. Glossary

Term	Definition
API	<b>Application Programming Interface.</b> An API is a set of routines, protocols, and tools for building software applications
Open Retailing	Open Retailing means both Service (Gas) Station and Convenience Store.
IFSF	International Forecourt Standards Forum
Internet	The name given to the interconnection of many isolated networks into a virtual single network.
IETF	The Internet Engineering Task Force
JSON	<b>JavaScript Object Notation;</b> is an open standard format that uses human-readable text to transmit data objects consisting of properties (name-value pairs), objects (sets of properties, other objects, and arrays), and arrays (ordered collections of data, or objects. JSON is in a format which is both human-readable and machine-readable.
OAS	OAS (OpenAPI Specification) is a specification for machine-readable interface files for describing, producing, consuming, and visualizing RESTful web services. The current version of OAS (as of the date of this document) is 3.0.
Port	A logical address of a service/protocol that is available on a particular device.
REST	<b>REpresentational State Transfer)</b> is an architectural style, and an approach to communications that is often used in the development of Web Services.
Service	A process that accepts connections from other processes, typically called client processes, either on the same device or a remote device.
TLS	<b>Transport Layer Security</b>