

# **JSON Integration for IO-Link**

## **REST and MQTT**

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This specification has been prepared by the IO-Link community.

This specification consists of three additional parts.

OpenAPI document [9] and AsyncAPI document [11]:

SHA-256 for OpenAPI document is

*sha256:24ab28933b513b8414654ae7c40d718be3ba1c8f9c638dca40d67be8cc5d53d3*

SHA-256 for AsyncAPI document is

*sha256:97601053adaab26392c1aba61aa0a27bcb42da58c8506e9ec8c7ae4435c9afe8*

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*sha256:6fd4d7d12ce29cd6a2010a960a81752e54317287160805074d3eb3bb796f5ad9*

Any comments, proposals, requests on this document or the related documents are appreciated and can be filed through the IO-Link public GitHub repository:

[https://github.com/iolinkcommunity/JSON\\_for\\_IO-Link/issue](https://github.com/iolinkcommunity/JSON_for_IO-Link/issue)

This can also be done via IO-Link CR database [www.io-link-projects.com](http://www.io-link-projects.com). Please provide name and email address.

**Login:** IOL-JSON

**Password:** Report

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## 0 Introduction

### 0.1 General

The base technology of IO-Link<sup>TM1</sup> is subject matter of the international standard IEC 61131-9 ([www.iec.ch](http://www.iec.ch)). IEC 61131-9 is part of a series of standards on programmable controllers and the associated peripherals and should be read in conjunction with other parts of the series.

### 0.2 Patent declaration

The IO-Link Community draws attention to the fact that it is claimed that compliance with this document may involve the use of patents concerning the point-to-point serial communication interface for small sensors and actuators as follows, where the [xx] notation indicates the holder of the patent right:

Patent number	[xx]	Title
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## IO-Link JSON Mapping

### 1 Motivation and scope

New use cases and requirements concerning the integration between modern IT systems and the production floor require new device interfaces. The connections today mainly focus on the integration of a device into fieldbuses and PLC systems. Cyclic data exchange and real time are the most important requirements for today field bus implementations. The techniques used are completely different than the ones used for the rest of the IT world. On the other hand, modern automation devices provide a way to communicate over TCP/IP networks beside the real time communication with the PLC over the field bus.

This document describes a device data model, objects and semantics for mapping on IT relevant connections or services.

This document describes the concept of a REST API and MQTT transmission.

- a) for data access to IO-Link Masters, Ports and Devices and the Gateway.
- b) for IODD file management (up/download).
- c) for MQTT client configuration.
- d) MQTT topics configuration and handling

The additional normative specifications are in [9] and in [11].

The MQTT client is based on MQTT Version 3.1.1 [3].

### 2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

Further references are found in the OpenAPI document [9].

### 3 Terms, definitions, symbols, abbreviated terms and conventions

#### 3.0 Common terms and definitions

For the purposes of this document, the terms and definitions given in IEC 61131-1 and IEC 61131-2, as well as the following apply.

##### Device

single passive peer to a Master such as a sensor or actuator.

NOTE: Uppercase "Device" is used for IO-Link equipment, while lowercase "device" is used in a generic manner

##### IODD

The XML based IO Device Description of an IO-Link Device see [2].

##### Master

Active peer connected through ports to one up to n Devices providing an interface to the gateway to the upper-level communication systems (e.g. PLCs or edge gateways).

NOTE: Uppercase "Master" is used for SDCI equipment, while lowercase "master" is used in a generic manner

##### Gateway

A Gateway consists of one or more IO-Link Masters.

##### Port

Communication interface of the Master to one Device.

**URL**

This is a Uniform Resource Locator.

**OpenAPI document**

A document (or set of documents) that defines or describes an API. An OpenAPI definition uses and conforms to the OpenAPI Specification [7].

**AsyncAPI document**

The AsyncAPI document is a communication contract between senders and receivers within an event-driven system. It specifies the payload content required for a service to send a message and provides the receiver with guidance about the message's properties [10].

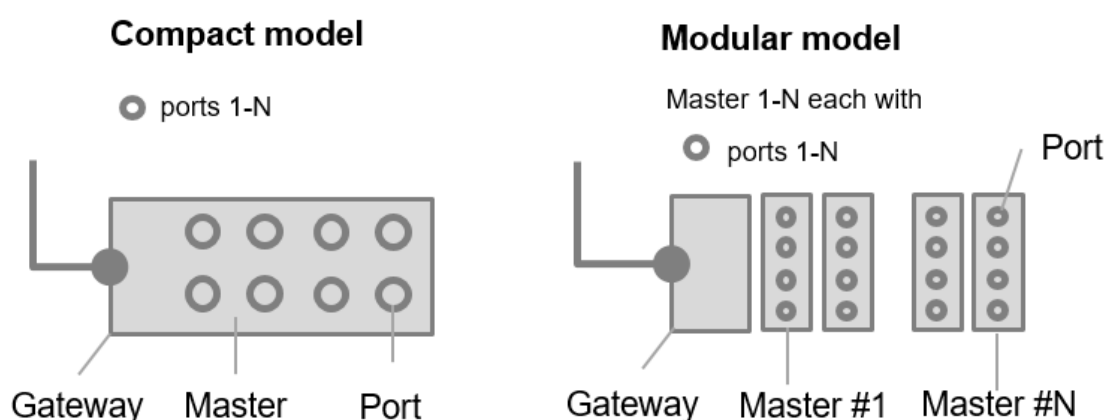
**OAuth**

OAuth is an authorization framework that allows third-party applications to access a user's resources without exposing their credentials, by using access tokens issued by an authorization server.

**4 Architectural and technical scope****4.0 General objectives**

As summarized in the IO-Link System Description, an IO-Link system consists of an IO-Link Master and IO-Link Devices. Devices can be connected to the master via cables or wireless.

A physical IO-Link Gateway consists of one or more Masters containing one or more ports. See Figure 1 – Physical Gateway models. On each port an IO-Link Device may be connected. The physical IO-Link Gateway may also have one or more Gateway applications (e.g. Webserver, OPC UA server or MQTT client).



**Figure 1 – Physical Gateway models**

The OpenAPI document for the REST API can be downloaded from the gateway via a designated endpoint, see [9]. This document could have adjustments in regards of vendor specific characteristics like used security schemas, supported endpoints or additional information.

**4.1 Features**

This specification supports three optional features “IODD support”, “MQTT support” and “Device Firmware Update”.

With IODD support enabled the REST API allows addressing and representation of data by names and data types defined in the IODD. Supported functionalities are the handling of specific IODDs like storing, updating, reading and deleting. Also, a list of all available IODDs on the gateway can be read.

With MQTT support enabled the REST API allows the configuration of an MQTT client (publisher or subscriber) and the connection to a MQTT broker.

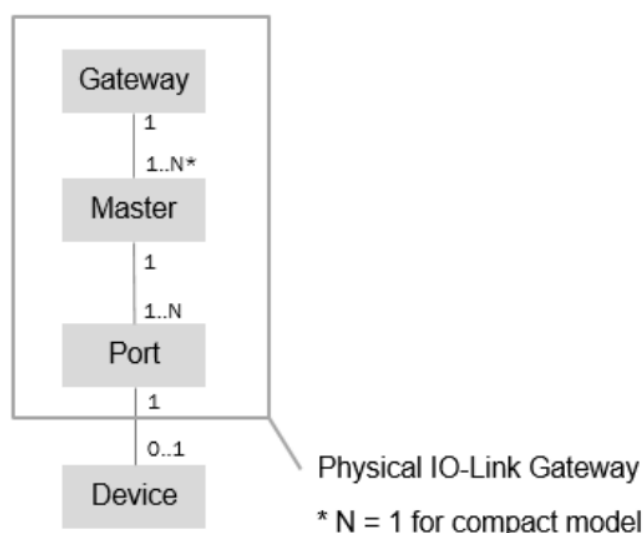
Supported functionalities for MQTT are

- creating, deleting and getting specific topics
- getting a list of topics
- reading and updating the configuration containing server address, username, password, client mode, last will and keep alive time.

The Device Firmware Update feature allows the updating of IO-Link Devices as specified in [12].

## 4.2 Device data and layer model

This device layer model (including Gateway, IO-Link Master and Devices) see Figure 2 is used to structure the REST API described in this specification. This layer model comprises compact modules containing one Master as well as modular devices with N Masters.



**Figure 2 - Device layer model**

Each layer has resources which are addressed by a URL path. The model shows that a physical gateway may have multiple gateway applications and one or more masters. Each master has one or more ports and on each port no or one device is connected.

## 4.3 Security

The parameter and configuration access should be controlled to assure only authorized clients can change the behaviour of Gateways, Masters and Devices. Also resetting or rebooting may not be allowed due to right restrictions. Requests for writing data without having permission to do so will respond with an error. The data will remain unchanged. It is recommended to rely on standard mechanisms like OAUTH or token-based access.

For data security it is recommended to use TLS-PSK with AES for the transport layer security as a minimum security level.

## 5 REST API

### 5.0 General rules

All endpoints in [9] which are not marked as optional shall be implemented.

Vendor-specific extensions for REST API commands and JSON key-value pairs are allowed.

A JSON for IO-Link Server shall return an error on all REST API commands and JSON key-value pairs that are not supported.

When sending an HTTP Post request, a client is not obligated to provide all objects or key value pairs. The resource must be updated by merging the newly received data with the existing data.

### 5.1 URL

The base path for this version is listed in Table 1.

**Table 1 – Base path**

Base path	Example	M/O/C
/iolink/v2	Example: “/iolink/v2/masters/1/ports/2/status”	M

### 5.2 HTTP methods

The following HTTP methods shall be used see Table 2 (reference for HTTP methods see [6]).

**Table 2 – HTTP methods**

HTTP Methods	Description	M/O/C
GET	Request data from the server	M
POST	Transmit data to the server	M
DELETE	Delete resources on the server	M

The interface description with all endpoints is described in the OpenAPI document see [9]

## **6 MQTT**

### **6.0 Features**

The AsyncAPI document describes the standard topics the gateway should implement. This follows the idea to have defined topics other MQTT clients can subscribe to.

To reduce the data traffic, it is possible to disable certain topics via the respective configuration endpoints.

Via REST API the MQTT configuration, topics and connection monitoring can be managed, as described in OpenAPI document see [9].

The ISDU access is done via request/reply pattern [13] described by the AsyncAPI document [11].

## **Annex A (normative)**

### **Status Codes and Errors on HTTP**

#### **A.1 HTTP Status Codes**

Each request on HTTP can response with or without an error indicated by the status code. All HTTP status codes are defined in [9].

#### **A.2 JSON Errors**

Each negative response indicated by a HTTP status code other than 200 is added by an individual JSON Error object in its HTTP body. All JSON Errors are defined in [9].

## **Annex B**

### **(informative)**

#### **B.1 Changelog**

The changelog of the release with introduced features and modifications can be found here [14].

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