

# OTV REST API Guide

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OTV REST API Guide

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# Revision History

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Revision	Release Date	Change Description
A	June 21, 2013	Initial release
B	February 24, 2014	Re-organized and clarified information throughout the document.

# 1 Introduction

---

The On-Ramp Wireless Total View (OTV) Representational State Transfer (REST) API provides an interface to query data from the OTV database. This API is considered “RESTful” because it adheres to the rules of data access and protocol prescribed by REST architecture. In general, a RESTful application allows machine-to-machine access to web application data via standard HTTP URLs.

## 2 Configuration and Security

### 2.1 Configuration

The OTV web core application must be installed to use the REST interface. Overall application properties for On-Ramp Wireless REST services are configured via the OTV config.properties file in the OTV instance directory. Editing these properties requires SSH (Secure Shell) access.

**Table 1. Global Configuration Properties**

Property	Description	Default
rest.services.enabled	Enables/disables overall service	true
rest.services.thread.interval	Sets the minimum seconds allowed between requests (per user)	0
rest.services.maxresults	Limits the result size for a query	50
rest.services.session.token.life	Sets the number of hours a token is valid for	24
rest.services.session.token.autoextend	This extends the life of the token each time a user uses the service	true

### 2.2 Setting Up a User Account

Any application that consumes On-Ramp Wireless REST services needs a valid OTV user account with a “Service” role. Users can be added/edited by an Administrator user by navigating to Admin → Users in the OTV user interface. The User must be assigned a device type in order to query the data for that particular device type.

To assign a role to the user, drag the role name from 'Available Roles' onto 'Assigned Role' list box. A user with no role is disabled from logging in.

#### Assigned Role

Service

To assign device types to a person, drag type names from 'Available Device Types' to 'Assigned Device Types'.

#### Assigned Device Types

WiYZ Remote: Methane Gas Sensor

**Figure 1. Editing User for Service Role**

## 3 Resource Overview

---

### 3.1 Resource Model Overview

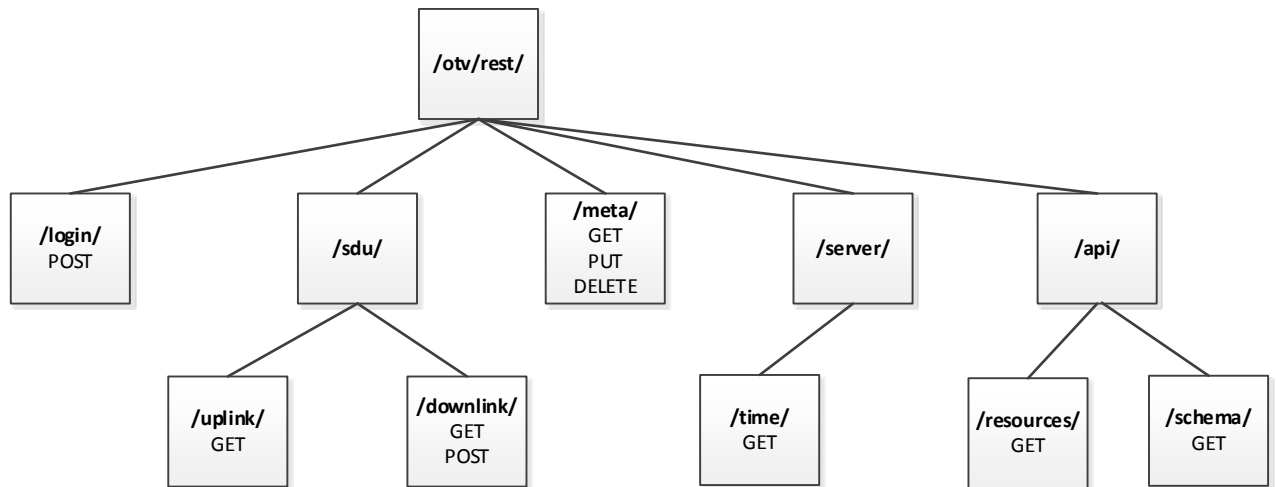


Figure 2. Resource Path Tree (with Supported HTTP Methods)

### 3.2 Root Path

The root path for all REST services is `/otv/rest/`. For example, `http(s)://{host}:{port}/otv/rest/`.

### 3.3 Resource Paths

All supported resource paths for the currently running OTV installation can be retrieved through the `/api/resources/` url. This resource returns an html file. A token is not required.

- **Request URL**

`https://{host}:{port}/otv/rest/api/resources/`

- **Request Type**

HTTP GET

#### Example

- **Request URL**

`https://localhost:8091/otv/rest/api/resources/`

### 3.4 Response Codes

All positive responses return an HTTP status code of 200 (OK).



## 3.5 Query Parameters

Parameters are optional and can be appended to the token (followed by “/?”) in any order. Parameters must be separated by the “&” character. If the “apptypeid” parameter is not present, then the response only contains unparsed raw application data. The parameters below are valid for both /uplink/ and /downlink/ resources.

**Table 2. REST Query Parameters**

Parameter	Description	Value Type
apptypeid=<value>	Restricts to SDUs that have the same application type ID.	Integer/long
id=<value>	Returns all nodes with an ID greater/equal to <value>.	Integer/long
received=<value>	Returns all nodes that were received greater/equal than the date (epoch long).	Integer/long (milliseconds since epoch)
nodeid=<value>	Restricts to just SDUs belonging to UlpNodeid of <value>.	Integer/long
asc=<value>	Orders results by ascending <value> where <value> is another valid parameter.	String
dsc=<value>	Orders results by descending <value> where <value> is another valid parameter.	String
firstresult=<value>	Sets the starting entry in the results list to <value>. This would be used for paging purposes.	Integer/Long
maxresults=<value>	Restricts results to <value> but this does not override the OTV config.properties value for maxresults.	Integer/long

## 4 Establishing a Session

---

An OTV REST session must be established before any other resource urls are attempted. This is done by posting user credentials to the /login resource. The user name and password must be a valid OTV user with REST services privileges. After a valid login, a token is returned for all subsequent HTTP requests. The token is a hexadecimal number with 32 characters. The token is required and must be appended to the resource URL. An example is provided below.

- **Request URL**

https://{host}:{port}/otv/rest/login

- **Request Type**

HTTP POST

- **Request Body XML Schema**

```
<?xml version="1.0" encoding="UTF-8" standalone="yes"?>
<xs:schema version="1.0" xmlns:xs="http://www.w3.org/2001/XMLSchema">
  <xs:element name="user" type="credentials"/>
  <xs:complexType name="credentials">
    <xs:sequence>
      <xs:element name="username" type="xs:string" minOccurs="0"/>
      <xs:element name="password" type="xs:string" minOccurs="0"/>
    </xs:sequence>
  </xs:complexType>
</xs:schema>
```

- **Response Body XML Schema**

```
<xs:element name="restsession" type="restToken"/>
<xs:complexType name="restToken">
  <xs:all>
    <xs:element name="expiration" type="xs:dateTime" nillable="true"/>
    <xs:element name="token" type="xs:string" nillable="true"/>
  </xs:all>
</xs:complexType>
```

### Example

- **Request URL**

https://localhost:8091/otv/rest/login

- **Request POST Body**

```
<?xml version="1.0" encoding="UTF-8"?>
<user>
  <username>rest</username>
  <password>password</password>
</user>
```

- **Response Body**

```
<?xml version="1.0" encoding="UTF-8" standalone="yes"?>
<restsession>
  <expiration>2013-05-22T08:02:08.643-07:00</expiration>
  <token>000000003ec489b7013ec78527100010</token>
</restsession>
```

## 5 Obtaining Server Time

---

The server time is the difference, measured in milliseconds, between the current time and midnight, January 1, 1970 UTC. This can be retrieved through the /server/time resource with a valid token from a successful login request.

- **Request URL**

https://{host}:{port}/otv/rest/server/time/{token}

- **Request Type**

HTTP GET

- **Response Body XML Schema**

```
<xs:element name="ServerTime" type="serverTime"/>
<xs:complexType name="serverTime">
  <xs:sequence>
    <xs:element name="milliseconds" type="xs:long" nillable="true"/>
  </xs:sequence>
</xs:complexType>
```

### Example

- **Request URL**

https://localhost:8091 /otv/rest/server/time/000000003ec489b7013ec78527100010

- **Response Body**

```
<?xml version="1.0" encoding="UTF-8" standalone="yes"?>
<ServerTime>
  <milliseconds>1369153544031</milliseconds>
</ServerTime>
```

## 6 Retrieving Uplink Data

---

The `/sdu/uplink/` resource is used to retrieve messages sent to the network by a device. The supported query parameters are as follows:

`apptypeid, id, received, nodeid, asc, dsc, firstresult, maxresults`

See *Table 2. REST Query Parameters* for more details.

- **Request URL**

`https://{host}:{port}/otv/rest/sdu/uplink/{token}`

- **Request Type**

HTTP GET

- **Response Body XML Schema (RawSdu)**

```
<?xml version="1.0" encoding="UTF-8" standalone="yes"?>
<xs:schema version="1.0" xmlns:xs="http://www.w3.org/2001/XMLSchema">

  <xs:element name="RawSdu" type="rawSdu"/>

  <xs:complexType name="rawSdu">
    <xs:all>
      <xs:element name="dataTypeId" type="xs:int"/>
      <xs:element name="sduHex" type="xs:string"/>
      <xs:element name="id" type="xs:Long"/>
      <xs:element name="nodeId" type="xs:Long"/>
      <xs:element name="received" type="xs:dateTime"/>
      <xs:element name="ulpNodeId" type="xs:Long"/>
    </xs:all>
  </xs:complexType></xs:schema>
```

### Example ( RawSdu – no device type specified )

- **Request URL (no device type specified)**

`https://localhost:8091/  
otv/rest/sdu/uplink/000000003ec489b7013ec78527100010?maxresults=1`

- **Response Body (no device type specified)**

```
<?xml version="1.0" encoding="UTF-8" standalone="yes"?>
<xmlListWrapper>
  <size>1</size>
  <RawSdu>
    <dataTypeId>10</dataTypeId>
    <sduHex>3C3F786D6C207665</sduHex>
    <id>1</id>
    <nodeId>1</nodeId>
    <received>2013-02-22T17:33:27-08:00</received>
    <ulpNodeId>199793</ulpNodeId>
  </RawSdu>
</xmlListWrapper>
```

### Example (apptypeid=10, ElectricAMISdu specified)

#### ■ **Request URL(apptypeid=10)**

https://localhost:8091/otv/rest/sdu/uplink/000000003ec489b7013ec78527100010?apptypeid=10&maxresults=1

#### ■ **Response Body (apptypeid=10)**

```
<?xml version="1.0" encoding="UTF-8" standalone="yes"?>
<xmlListWrapper>
  <size>1</size>
  <ElectricAMISdu>
    <AppTypeID>10</AppTypeID>
    <App_Device_Id>199793</App_Device_Id>
    <Failures/>
    <messageSummary>Received Meter information, Serial Number:
56138508      </messageSummary>
    <Device_Id>1</Device_Id>
    <Message_Received>1361583207000</Message_Received>
    <ULP_Node_Id>199793</ULP_Node_Id>
    <UplinkType>METER_INFO</UplinkType>
    <MetaAttribs/>
  </ElectricAMISdu>
</xmlListWrapper>
```

### Special Notes

If a device becomes unreachable, meaning OTV has not received an uplink message within a certain configurable time period, an empty uplink sdu entry is created in the database. Thus, when querying for uplink messages via the REST interface, you may see a RawSdu entry as shown below:

```
<?xml version="1.0" encoding="UTF-8" standalone="yes"?>
<xmlListWrapper>
  <size>1</size>
  <RawSdu>
    <dataTypeId>20</dataTypeId>
    <sduHex>00</sduHex>
    <id>1</id>
    <nodeId>1</nodeId>
    <received>2013-01-01T10:30:25-08:00</received>
    <ulpNodeId>111</ulpNodeId>
  </RawSdu>
</xmlListWrapper>
```

## 7 Sending Downlink Data

---

Messages can be sent to devices using the /sdu/downlink/ resource.

- **Request URL**

https://{host}:{port}/otv/rest/sdu/downlink/{token}

- **Request Type**

HTTP POST

- **Request Body XML Schema**

```
<xs:element name="downlinkrequest">
  <xs:complexType>
    <xs:all>
      <xs:element name="flush" type="xs:boolean" nillable="true"/>
      <xs:element name="payload" type="xs:string" nillable="true"/>
      <xs:element name="UlpNodeId" type="xs:long" nillable="true"/>
    </xs:all>
  </xs:complexType>
</xs:element>
```

The payload must be in hexadecimal characters and may include spaces; all white space are deleted before the message is sent.

### Example

- **Request URL**

https://localhost:8091/otv/rest/sdu/downlink/000000003ec489b7013ec78527100010

- **Request POST Body**

```
<?xml version="1.0" encoding="UTF-8"?>
<downlinkrequest>
  <UlpNodeId>111</UlpNodeId>
  <payload>24 FF 01 70 C0 03 01 06</payload>
  <flush>false</flush>
</downlinkrequest>
```

- **Response Body**

```
<?xml version="1.0" encoding="UTF-8" standalone="yes" ?>
<DownlinkSdu>
  <App_Device_Id>111</App_Device_Id>
  <dataTypeId>111</dataTypeId>
  <payload>
    <downlinkMessageParams>
      <hex>24FF0170C0030106</hex>
      <name>dl_payload</name>
    </downlinkMessageParams>
  </payload>
  <Message_Id>11</Message_Id>
  <Device_Id>6</Device_Id>
  <Message_Received>1389048679000</Message_Received>
  <ackstatus>-1</ackstatus>
  <ULP_Node_Id>111</ULP_Node_Id>
</DownlinkSdu>
```

## 8 Retrieving Downlink Data

---

The /sdu/downlink resource is also used to retrieve messages that have already been sent to a device from the network.

### ■ Request URL

`https://{host}:{port}/otv/rest/sdu/downlink/{token}`

The supported query parameters are as follows:

apptypeid, id, received, nodeid, asc, dsc, firstresult, maxresults

See *Table 2. REST Query Parameters* for more details.

### ■ Request Type

HTTP GET

### ■ Response Body XML Schema

```
<?xml version="1.0" encoding="UTF-8" standalone="yes"?>
<xs:schema version="1.0" xmlns:xs="http://www.w3.org/2001/XMLSchema">

  <xs:element name="DownLinkSdu" type="downlinkSdu"/>

  <xs:complexType name="downlinkSdu">
    <xs:all>
      <xs:element name="App_Device_Id" type="xs:long"/>
      <xs:element name="dataTypeId" type="xs:int"/>
      <xs:element name="payload">
        <xs:complexType>
          <xs:sequence>
            <xs:element name="downlinkMessageParams"
type="downlinkSduRawChunk" nillable="true" minOccurs="0"
maxOccurs="unbounded"/>
          </xs:sequence>
        </xs:complexType>
      </xs:element>
      <xs:element name="Message_Id" type="xs:long"/>
      <xs:element name="Failures">
        <xs:complexType>
          <xs:sequence>
            <xs:element name="item" type="FailureType" nillable="true"
minOccurs="0" maxOccurs="unbounded"/>
          </xs:sequence>
        </xs:complexType>
      </xs:element>
      <xs:element name="Device_Id" type="xs:long"/>
      <xs:element name="Message_Received" type="xs:long"/>
      <xs:element name="ackstatus" type="xs:string"/>
      <xs:element name="ULP_Node_Id" type="xs:long"/>
      <xs:element name="MetaAttribs">
        <xs:complexType>
          <xs:sequence>
```

```

        <xs:element name="Attrib" type="XMLMetaAttrib" minOccurs="0"
maxOccurs="unbounded"/>
    </xs:sequence>
</xs:complexType>
</xs:element>
</xs:all>
</xs:complexType>

<xs:complexType name="downLinkSduRawChunk">
    <xs:sequence>
        <xs:element name="hex" type="xs:string" minOccurs="0"/>
        <xs:element name="name" type="xs:string" minOccurs="0"/>
    </xs:sequence>
</xs:complexType>

<xs:complexType name="FailureType">
    <xs:sequence>
        <xs:element name="Id" type="xs:int"/>
        <xs:element name="Severity" type="xs:int" nillable="true"/>
        <xs:element name="Time" type="xs:long" nillable="true"/>
    </xs:sequence>
</xs:complexType>

<xs:complexType name="XMLMetaAttrib">
    <xs:sequence>
        <xs:element name="Name" type="xs:string" nillable="true"/>
        <xs:element name="Value" type="xs:string" nillable="true"/>
    </xs:sequence>
</xs:complexType>

<xs:simpleType name="mtid">
    <xs:restriction base="xs:string">
        <xs:enumeration value="NONE"/>
        <xs:enumeration value="DATA"/>
        <xs:enumeration value="FLUSH"/>
    </xs:restriction>
</xs:simpleType>

<xs:simpleType name="ackStatusCodes">
    <xs:restriction base="xs:string">
        <xs:enumeration value="-1 MAC_DL_SDU_STATUS_PENDING"/>
        <xs:enumeration value="0 MAC_DL_SDU_STATUS_ACKED"/>
        <xs:enumeration value="1 MAC_DL_SDU_STATUS_UNKNOWN"/>
        <xs:enumeration value="2 MAC_DL_SDU_STATUS_DROPPED"/>
        <xs:enumeration value="3 MAC_DL_SDU_STATUS_NODE_NOT_CONNECTED"/>
        <xs:enumeration value="4 MAC_DL_SDU_STATUS_UNKNOWN_NODE_ID"/>
        <xs:enumeration value="5 MAC_DL_SDU_STATUS_INVALID_PAYLOAD_SIZE"/>
        <xs:enumeration value="6 MAC_DL_SDU_STATUS_QUEUE_FULL"/>
        <xs:enumeration value="10 REQUEST_STATUS_SUCCESS"/>
        <xs:enumeration value="11 TAG_ALREADY_EXISTS"/>
        <xs:enumeration value="128 APP_TIMEOUT"/>
        <xs:enumeration value="129 APP_GW_UNREACHABLE"/>
        <xs:enumeration value="130 APP_PROCESS_ERROR"/>
    </xs:restriction>
</xs:simpleType>
</xs:schema>

```



## Example

### ■ **Request URL**

https://localhost:8091/otv/rest/sdu/downlink/000000003ec489b7013ec78527100010?nodeid=510&maxresults=1

### ■ **Response Body**

```
<?xml version="1.0" encoding="UTF-8" standalone="yes"?>
<xmlListWrapper xmlns:xsi="http://www.w3.org/2001/XMLSchema-
instance">
  <size>1</size>
  <DownlinkSdu>
    <App_Device_Id>111</App_Device_Id>
    <dataTypeId>111</dataTypeId>
    <payload>
      <downlinkMessageParams>
        <hex>DEADBEEF</hex>
        <name>dl_payload</name>
      </downlinkMessageParams>
    </payload>
    <Message_Id>8</Message_Id>
    <Device_Id>6</Device_Id>
    <Message_Received>1388776239000</Message_Received>
    <ackstatus>-1</ackstatus>
    <ULP_Node_Id>111</ULP_Node_Id>
  </DownlinkSdu>
</xmlListWrapper>
```

## 9 Retrieving Device Metadata

---

Devices may have metadata, in the form of key value pairs, stored for searching or filtering or other application specific information. The /meta/ resource can be used to retrieve existing metadata stored for a device.

- **Request URL**

https://{host}:{port}/otv/rest/meta/{token}?nodeid={nodeid}

- **Request Type**

HTTP GET

- **Response Body XML Schema**

```
<xs:element name="MetaData" type="metaData"/>

<xs:complexType name="Attribute">
  <xs:sequence>
    <xs:element name="Name" type="xs:string" nillable="true"/>
    <xs:element name="Value" type="xs:string" nillable="true"/>
  </xs:sequence>
</xs:complexType>

<xs:complexType name="metaData">
  <xs:sequence>
    <xs:element name="Attributes" type="Attribute" minOccurs="0"
maxOccurs="unbounded"/>
  </xs:sequence>
</xs:complexType>
```

### Example

- **Request URL**

https://localhost:8091/otv/rest/meta/000000003ec489b7013ec78527100010?nodeid=8604

- **Response Body**

```
<?xml version="1.0" encoding="UTF-8" standalone="yes" ?>
<MetaData>
  <Attribute>
    <Name>Description</Name>
    <Value>this is the description</Value>
  </Attribute>
  <Attribute>
    <Name>Latitude</Name>
    <Value />
  </Attribute>
  <Attribute>
    <Name>Longitude</Name>
    <Value />
  </Attribute>
</MetaData>
```

# 10 Updating Device Metadata

---

Device metadata may be updated by submitting a PUT request on the /meta resource. This does not do a complete replacement of all metadata but only updates/adds the attributes provided in the PUT XML body.

- **Request URL**

https://{host}:{port}/otv/rest/meta/{token}?nodeid={nodeid}

- **Request Type**

HTTP PUT

- **Request and Response Body XML Schema**

```
<xs:element name="MetaData" type="metaData"/>

<xs:complexType name="Attribute">
  <xs:sequence>
    <xs:element name="Name" type="xs:string" nillable="true"/>
    <xs:element name="Value" type="xs:string" nillable="true"/>
  </xs:sequence>
</xs:complexType>

<xs:complexType name="metaData">
  <xs:sequence>
    <xs:element name="Attributes" type="Attribute" minOccurs="0"
maxOccurs="unbounded"/>
  </xs:sequence>
</xs:complexType>
```

## Example

- **Request URL**

https://localhost:8091/otv/rest/meta/000000003ec489b7013ec78527100010?nodeid=8604

- **Request PUT Body**

```
<?xml version="1.0" encoding="UTF-8" standalone="yes"?>
<MetaData xmlns:xs="http://www.w3.org/2001/XMLSchema"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance">
  <Attribute>
    <Name>Description</Name>
    <Value>this is the updated description</Value>
  </Attribute>
</MetaData>
```

- **Response Body**

```
<?xml version="1.0" encoding="UTF-8" standalone="yes"?>
<MetaData>
  <Attribute>
    <Name>Description</Name>
    <Value>this is the updated description</Value>
```

```
    </Attribute>
  <Attribute>
    <Name>Latitude</Name>
    <Value></Value>
  </Attribute>
  <Attribute>
    <Name>Longitude</Name>
    <Value></Value>
  </Attribute>
</MetaData>
```

# 11 Deleting Device Metadata

---

Device metadata may be updated by submitting a DELETE request on the /meta resource. This deletes all metadata associated with the device.

- **Request URL**

https://{host}:{port}/otv/rest/meta/{token}?nodeid={nodeid}

- **Request Type**

HTTP DELETE

- **Response Body XML Schema**

```
<xs:element name="MetaData" type="metaData"/>

<xs:complexType name="Attribute">
  <xs:sequence>
    <xs:element name="Name" type="xs:string" nillable="true"/>
    <xs:element name="Value" type="xs:string" nillable="true"/>
  </xs:sequence>
</xs:complexType>

<xs:complexType name="metaData">
  <xs:sequence>
    <xs:element name="Attributes" type="Attribute" minOccurs="0"
maxOccurs="unbounded"/>
  </xs:sequence>
</xs:complexType>
```

## Example

- **Request URL**

https://localhost:8091/otv/rest/meta/000000003ec489b7013ec78527100010?nodeid=8604

- **Response Body**

```
<?xml version="1.0" encoding="UTF-8" standalone="yes"?>
<MetaData />
```

# 12 Retrieving XML Schema Definitions

---

The `/api/schema/` resource returns the xml schemas used for the REST interface. A token is not required. The query parameter “apptypeid” can be used to retrieve the schema for a specific device type.

See Table 2. REST Query Parameters.

- **Request URL**

`https://{host}:{port}/otv/rest/api/schema/`

- **Request Type**

HTTP GET

## Example

- **Request URL (no device type specified)**

`https://localhost:8091/otv/rest/api/schema/`

- **Response Body (no device type specified)**

```
<?xml version="1.0" encoding="UTF-8" standalone="yes"?>
<xsi:schema elementFormDefault="unqualified" version="1.0"
xmlns:xsi="http://www.w3.org/2001/XMLSchema">

  <xsi:element name="DownlinkSdu" type="downlinkSdu"/>

  <xsi:element name="GroupMembership" type="mudGroupMembershipStatus"/>

  <xsi:element name="GroupMembershipList" type="mudGroupList"/>

  <xsi:element name="MetaData" type="metaData"/>

  <xsi:element name="NodeMembership" type="mudNodeMembershipStatus"/>

  <xsi:element name="RawSdu" type="rawSdu"/>

  <xsi:element name="Response" type="genericRestResponse"/>

  <xsi:element name="ServerTime" type="serverTime"/>

  <xsi:element name="downlinkrequest" type="restDownlinkRequest"/>

  <xsi:element name="restsession" type="restToken"/>

  <xsi:element name="user" type="credentials"/>

  <xsi:element name="xmlListWrapper" type="xmlListWrapper"/>

  <xsi:complexType name="credentials">
    <xsi:sequence>
      <xsi:element name="username" type="xsi:string" minOccurs="0"/>
      <xsi:element name="password" type="xsi:string" minOccurs="0"/>
    </xsi:sequence>
  </xsi:complexType>
</xsi:schema>
```

```

    </xsi:sequence>
  </xsi:complexType>

  <xsi:complexType name="restToken">
    <xsi:all>
      <xsi:element name="expiration" type="xsi:dateTime"
nillable="true"/>
      <xsi:element name="token" type="xsi:string" nillable="true"/>
    </xsi:all>
  </xsi:complexType>

  <xsi:complexType name="serverTime">
    <xsi:sequence>
      <xsi:element name="milliseconds" type="xsi:long"
nillable="true"/>
    </xsi:sequence>
  </xsi:complexType>

  <xsi:complexType name="xmlListWrapper">
    <xsi:sequence>
      <xsi:element name="size" type="xsi:int"/>
      <xsi:any processContents="skip" namespace="##other" minOccurs="0"
maxOccurs="unbounded"/>
    </xsi:sequence>
  </xsi:complexType>

  <xsi:complexType name="rawSdu">
    <xsi:all>
      <xsi:element name="dataTypeId" type="xsi:int"/>
      <xsi:element name="sduHex" type="xsi:string"/>
      <xsi:element name="id" type="xsi:long"/>
      <xsi:element name="nodeId" type="xsi:long"/>
      <xsi:element name="received" type="xsi:dateTime"/>
      <xsi:element name="ulpNodeId" type="xsi:long"/>
    </xsi:all>
  </xsi:complexType>

  <xsi:complexType name="downlinkSdu">
    <xsi:all>
      <xsi:element name="App_Device_Id" type="xsi:long"/>
      <xsi:element name="dataTypeId" type="xsi:int"/>
      <xsi:element name="payload">
        <xsi:complexType>
          <xsi:sequence>
            <xsi:element name="downlinkMessageParams"
type="downlinkSduRawChunk" nillable="true" minOccurs="0"
maxOccurs="unbounded"/>
          </xsi:sequence>
        </xsi:complexType>
      </xsi:element>
      <xsi:element name="Message_Id" type="xsi:long"/>
      <xsi:element name="Failures">
        <xsi:complexType>
          <xsi:sequence>
            <xsi:element name="item" type="FailureType" nillable="true"
minOccurs="0" maxOccurs="unbounded"/>
          </xsi:sequence>
        </xsi:complexType>
      </xsi:element>
    </xsi:all>
  </xsi:complexType>

```

```

        </xsi:sequence>
      </xsi:complexType>
    </xsi:element>
    <xsi:element name="Device_Id" type="xsi:long"/>
    <xsi:element name="Message_Received" type="xsi:long"/>
    <xsi:element name="ackstatus" type="xsi:string"/>
    <xsi:element name="ULP_Node_Id" type="xsi:long"/>
    <xsi:element name="MetaAttribs">
      <xsi:complexType>
        <xsi:sequence>
          <xsi:element name="Attrib" type="XMLMetaAttrib"
minOccurs="0" maxOccurs="unbounded"/>
        </xsi:sequence>
      </xsi:complexType>
    </xsi:element>
  </xsi:all>
</xsi:complexType>

<xsi:complexType name="downlinkSduRawChunk">
  <xsi:sequence>
    <xsi:element name="hex" type="xsi:string" minOccurs="0"/>
    <xsi:element name="name" type="xsi:string" minOccurs="0"/>
  </xsi:sequence>
</xsi:complexType>

<xsi:complexType name="FailureType">
  <xsi:sequence>
    <xsi:element name="Id" type="xsi:int"/>
    <xsi:element name="Severity" type="xsi:int" nillable="true"/>
    <xsi:element name="Time" type="xsi:long" nillable="true"/>
  </xsi:sequence>
</xsi:complexType>

<xsi:complexType name="XMLMetaAttrib">
  <xsi:sequence>
    <xsi:element name="Name" type="xsi:string" nillable="true"/>
    <xsi:element name="Value" type="xsi:string" nillable="true"/>
  </xsi:sequence>
</xsi:complexType>

<xsi:complexType name="restDownlinkRequest">
  <xsi:all>
    <xsi:element name="description" type="xsi:string" nillable="true"
minOccurs="0"/>
    <xsi:element name="flush" type="xsi:boolean" nillable="true"/>
    <xsi:element name="UlpNodeId" type="xsi:long" nillable="true"
minOccurs="0"/>
    <xsi:element name="payload" type="xsi:string" nillable="true"/>
  </xsi:all>
</xsi:complexType>

<xsi:complexType name="genericRestResponse">
  <xsi:sequence>
    <xsi:element name="message" type="xsi:string" minOccurs="0"/>
    <xsi:element name="result" type="code" minOccurs="0"/>
  </xsi:sequence>

```



```

</xsi:complexType>

<xsi:complexType name="metaData">
  <xsi:sequence>
    <xsi:element name="Attributes" minOccurs="0">
      <xsi:complexType>
        <xsi:sequence>
          <xsi:element name="Attribute" type="MetaAttrib"
minOccurs="0" maxOccurs="unbounded"/>
        </xsi:sequence>
      </xsi:complexType>
    </xsi:element>
  </xsi:sequence>
</xsi:complexType>

<xsi:complexType name="MetaAttrib">
  <xsi:sequence>
    <xsi:element name="Name" type="xsi:string" nillable="true"/>
    <xsi:element name="Value" type="xsi:string" nillable="true"/>
  </xsi:sequence>
</xsi:complexType>

<xsi:complexType name="mudGroupList">
  <xsi:sequence>
    <xsi:element ref="GroupMembership" minOccurs="0"
maxOccurs="unbounded"/>
  </xsi:sequence>
</xsi:complexType>

<xsi:complexType name="mudGroupMembershipStatus">
  <xsi:sequence>
    <xsi:element name="name" type="xsi:string" minOccurs="0"/>
    <xsi:element name="groupid" type="xsi:string" minOccurs="0"/>
    <xsi:element name="GroupMember" type="GroupMember" minOccurs="0"
maxOccurs="unbounded"/>
  </xsi:sequence>
</xsi:complexType>

<xsi:complexType name="GroupMember">
  <xsi:sequence>
    <xsi:element name="nodeid" type="xsi:long" nillable="true"/>
    <xsi:element name="status" type="mudMembershipState"
nillable="true"/>
  </xsi:sequence>
</xsi:complexType>

<xsi:complexType name="mudNodeMembershipStatus">
  <xsi:sequence>
    <xsi:element name="id" type="xsi:long" minOccurs="0"/>
    <xsi:element name="NodeMember" type="NodeMember" minOccurs="0"
maxOccurs="unbounded"/>
  </xsi:sequence>
</xsi:complexType>

<xsi:complexType name="NodeMember">
  <xsi:sequence>

```

```
<xsi:element name="name" type="xsi:string" nillable="true"/>
<xsi:element name="groupid" type="xsi:string" nillable="true"/>
<xsi:element name="status" type="mudMembershipState"
nillable="true"/>
</xsi:sequence>
</xsi:complexType>

<xsi:simpleType name="code">
  <xsi:restriction base="xsi:string">
    <xsi:enumeration value="PROCESSED"/>
    <xsi:enumeration value="DROPPED"/>
  </xsi:restriction>
</xsi:simpleType>

<xsi:simpleType name="mudMembershipState">
  <xsi:restriction base="xsi:string">
    <xsi:enumeration value="PENDING_ASSIGNMENT"/>
    <xsi:enumeration value="ASSIGNED"/>
    <xsi:enumeration value="PENDING_DEASSIGNMENT"/>
    <xsi:enumeration value="DEASSIGNED"/>
  </xsi:restriction>
</xsi:simpleType>
</xsi:schema>
```

# Appendix A Uplink SDU Schema Reference

---

The XML *payload* is the body data or contents (e.g., the “cargo”) of a data transmission as opposed to the *wrapper* which is the boilerplate XML around the content. As such, the payload is the *variable* part of the reply. This chapter provides the XML schemas (xsd) for uplink SDUs for various device types. The schemas can also be obtained by using the /api/schema/ resource.

## A.1 WiYZSdu Schema

```
<?xml version="1.0" encoding="UTF-8" standalone="yes"?>
<xs:schema version="1.0" xmlns:xs="http://www.w3.org/2001/XMLSchema">

  <xs:element name="WiYZProcessControlValue" type="WiYZProcessControlValue"/>

  <xs:element name="WiYZSdu" type="WiYZSdu"/>

  <xs:complexType name="WiYZSdu">
    <xs:all>
      <xs:element name="AppTypeID" type="xs:int"/>
      <xs:element name="isAlarm" type="xs:boolean"/>
      <xs:element name="alertClass" type="xs:int"/>
      <xs:element name="alertCounter" type="xs:int"/>
      <xs:element name="alertDirection" type="xs:int"/>
      <xs:element name="alertId" type="xs:int"/>
      <xs:element name="alertReserved" type="xs:int"/>
      <xs:element name="App_Device_Id" type="xs:Long"/>
      <xs:element name="sensorData">
        <xs:complexType>
          <xs:sequence>
            <xs:element name="sensor" type="WiYZProcessControlValue" minOccurs="0"
maxOccurs="unbounded"/>
          </xs:sequence>
        </xs:complexType>
      </xs:element>
      <xs:element name="destinationOID" type="xs:int"/>
      <xs:element name="downlinkResponse" type="xs:string"/>
      <xs:element name="Message_Id" type="xs:Long"/>
      <xs:element name="Failures">
        <xs:complexType>
          <xs:sequence>
            <xs:element name="item" type="FailureType" nillable="true" minOccurs="0"
maxOccurs="unbounded"/>
          </xs:sequence>
        </xs:complexType>
      </xs:element>
      <xs:element name="messageType" type="xs:int"/>
      <xs:element name="Device_Id" type="xs:Long"/>
      <xs:element name="Message_Received" type="xs:Long"/>
      <xs:element name="sduTimestamp" type="xs:Long"/>
      <xs:element name="sourceOID" type="xs:int"/>
    </xs:all>
  </xs:complexType>
</xs:schema>
```

```

    <xs:element name="ULP_Node_Id" type="xs:Long"/>
    <xs:element name="MetaAttribs">
      <xs:complexType>
        <xs:sequence>
          <xs:element name="Attrib" type="XMLMetaAttrib" minOccurs="0"
maxOccurs="unbounded"/>
        </xs:sequence>
      </xs:complexType>
    </xs:element>
  </xs:all>
</xs:complexType>

<xs:complexType name="wiYZProcessControlValue">
  <xs:all>
    <xs:element name="id" type="xs:Long"/>
    <xs:element name="limitstatus" type="xs:int"/>
    <xs:element name="nodeId" type="xs:Long"/>
    <xs:element name="portId" type="xs:Long"/>
    <xs:element name="quality" type="xs:int"/>
    <xs:element name="reserved" type="xs:int"/>
    <xs:element name="scaledValue" type="xs:string"/>
    <xs:element name="sduId" type="xs:Long"/>
    <xs:element name="substatus" type="xs:int"/>
    <xs:element name="rawValue" type="xs:string"/>
  </xs:all>
</xs:complexType>

<xs:complexType name="FailureType">
  <xs:sequence>
    <xs:element name="Id" type="xs:int"/>
    <xs:element name="Severity" type="xs:int" nillable="true"/>
    <xs:element name="Time" type="xs:Long" nillable="true"/>
  </xs:sequence>
</xs:complexType>

<xs:complexType name="XMLMetaAttrib">
  <xs:sequence>
    <xs:element name="Name" type="xs:string" nillable="true"/>
    <xs:element name="Value" type="xs:string" nillable="true"/>
  </xs:sequence>
</xs:complexType>
</xs:schema>

```

## A.2 FAALightSdu Schema

```

<?xml version="1.0" encoding="UTF-8" standalone="yes"?>
<xs:schema version="1.0" xmlns:xs="http://www.w3.org/2001/XMLSchema">

  <xs:element name="FAALightSdu" type="faaLightSdu"/>

  <xs:complexType name="faaLightSdu">
    <xs:all>
      <xs:element name="AppTypeID" type="xs:int"/>

```

```

<xs:element name="App_Device_Id" type="xs:Long"/>
<xs:element name="computedLightStatus" type="xs:Long" nillable="true"/>
<xs:element name="computedTimeOfDay" type="xs:Long" nillable="true"/>
<xs:element name="dipSwitch" type="xs:int" nillable="true"/>
<xs:element name="Message_Id" type="xs:Long"/>
<xs:element name="intrusionDetection" type="xs:Long" nillable="true"/>
<xs:element name="invalidRmuConfig" type="xs:int" nillable="true"/>
<xs:element name="Failures">
  <xs:complexType>
    <xs:sequence>
      <xs:element name="item" type="FailureType" nillable="true" minOccurs="0"
maxOccurs="unbounded"/>
    </xs:sequence>
  </xs:complexType>
</xs:element>
<xs:element name="LightNotFunctional" type="xs:Long" nillable="true"/>
<xs:element name="lightsOutLatch" type="xs:int" nillable="true"/>
<xs:element name="nightTooShort" type="xs:int" nillable="true"/>
<xs:element name="Device_Id" type="xs:Long"/>
<xs:element name="opCode" type="xs:Long" nillable="true"/>
<xs:element name="rmuVersion" type="xs:Long" nillable="true"/>
<xs:element name="powerSupplyStatus" type="xs:Long" nillable="true"/>
<xs:element name="powerSupplyType" type="xs:Long" nillable="true"/>
<xs:element name="pushbuttonStatus" type="xs:Long" nillable="true"/>
<xs:element name="Message_Received" type="xs:Long"/>
<xs:element name="replaceBattery" type="xs:Long" nillable="true"/>
<xs:element name="timeOfDay" type="xs:Long" nillable="true"/>
<xs:element name="timeOfDayHoursPast" type="xs:Long" nillable="true"/>
<xs:element name="totalBulbs" type="xs:Long" nillable="true"/>
<xs:element name="ULP_Node_Id" type="xs:Long"/>
<xs:element name="MetaAttribs">
  <xs:complexType>
    <xs:sequence>
      <xs:element name="Attrib" type="XMLMetaAttrib" minOccurs="0"
maxOccurs="unbounded"/>
    </xs:sequence>
  </xs:complexType>
</xs:element>
</xs:all>
</xs:complexType>

<xs:complexType name="FailureType">
  <xs:sequence>
    <xs:element name="Id" type="xs:int"/>
    <xs:element name="Severity" type="xs:int" nillable="true"/>
    <xs:element name="Time" type="xs:Long" nillable="true"/>
  </xs:sequence>
</xs:complexType>

<xs:complexType name="XMLMetaAttrib">
  <xs:sequence>
    <xs:element name="Name" type="xs:string" nillable="true"/>
    <xs:element name="Value" type="xs:string" nillable="true"/>
  </xs:sequence>

```

```
</xs:complexType>
</xs:schema>
```

## A.3 FCISdu Schema

```
<?xml version="1.0" encoding="UTF-8" standalone="yes"?>
<xs:schema version="1.0" xmlns:xs="http://www.w3.org/2001/XMLSchema">

  <xs:element name="FCISdu" type="fciSdu"/>

  <xs:complexType name="PastHourlyAverageCurrentAmps">
    <xs:sequence>
      <xs:element name="Value" type="xs:deOTVL" minOccurs="0" maxOccurs="unbounded"/>
    </xs:sequence>
    <xs:attribute name="BaseTime" type="xs:Long" use="required"/>
  </xs:complexType>

  <xs:complexType name="PastHourlyAverageTemperatureCelsius">
    <xs:sequence>
      <xs:element name="Value" type="xs:deOTVL" minOccurs="0" maxOccurs="unbounded"/>
    </xs:sequence>
    <xs:attribute name="BaseTime" type="xs:Long" use="required"/>
  </xs:complexType>

  <xs:complexType name="fciSdu">
    <xs:all>
      <xs:element name="AppTypeID" type="xs:int"/>
      <xs:element name="Version" type="Version"/>
      <xs:element name="ReportType" type="ReportType"/>
      <xs:element name="V2ReportType" type="V2ReportType"/>
      <xs:element name="ReportTimestamp" type="xs:dateTime"/>
      <xs:element name="millis" type="xs:int"/>
      <xs:element name="BatteryVoltage" type="xs:int"/>
      <xs:element name="MechanicalTargetFaulted" type="xs:boolean"/>
      <xs:element name="LowBattery" type="xs:boolean"/>
      <xs:element name="Armed" type="xs:boolean"/>
      <xs:element name="FlashError" type="xs:boolean"/>
      <xs:element name="RamError" type="xs:boolean"/>
      <xs:element name="FCIEventLarm" type="xs:boolean"/>
      <xs:element name="FirmwareRelease" type="xs:int"/>
      <xs:element name="FirmwareReleaseMinor" type="xs:int"/>
      <xs:element name="FaultThresholdAmps" type="xs:int"/>
      <xs:element name="FaultMagnitudeAmps" type="xs:int"/>
      <xs:element name="BatteryRemainingAmpSeconds" type="xs:int"/>
      <xs:element name="MomentaryFaultCount" type="xs:int"/>
      <xs:element name="MomentaryLoadPickupCount" type="xs:int"/>
      <xs:element name="MomentaryLossOfCurrentCount" type="xs:int"/>
      <xs:element name="MomentaryLossOfVoltageCount" type="xs:int"/>
      <xs:element name="MomentaryFaultDisturbance" type="xs:int"/>
      <xs:element name="CumulativeFaultCount" type="xs:int"/>
      <xs:element name="CumulativeLossOfCurrentCount" type="xs:int"/>
      <xs:element name="CumulativeLossOfVoltageCount" type="xs:int"/>
      <xs:element name="CumulativeLossOfCurrentAndVoltageCount" type="xs:int"/>
    </xs:all>
  </xs:complexType>
```

```

    <xs:element name="PeakLoadFlag" type="xs:boolean"/>
    <xs:element name="StatisticIntervals" type="xs:int"/>
    <xs:element name="App_Device_Id" type="xs:long"/>
    <xs:element name="Message_Id" type="xs:long"/>
    <xs:element name="Failures">
      <xs:complexType>
        <xs:sequence>
          <xs:element name="item" type="FailureType" nillable="true" minOccurs="0"
maxOccurs="unbounded"/>
        </xs:sequence>
      </xs:complexType>
    </xs:element>
    <xs:element name="Device_Id" type="xs:long"/>
    <xs:element name="PastHourlyAverageCurrentAmps"
type="PastHourlyAverageCurrentAmps"/>
    <xs:element name="PastHourlyAverageTemperatureCelsius"
type="PastHourlyAverageTemperatureCelsius"/>
    <xs:element name="Message_Received" type="xs:long"/>
    <xs:element name="ULP_Node_Id" type="xs:long"/>
    <xs:element name="MetaAttribs">
      <xs:complexType>
        <xs:sequence>
          <xs:element name="Attrib" type="XMLMetaAttrib" minOccurs="0"
maxOccurs="unbounded"/>
        </xs:sequence>
      </xs:complexType>
    </xs:element>
  </xs:all>
</xs:complexType>

<xs:complexType name="FailureType">
  <xs:sequence>
    <xs:element name="Id" type="xs:int"/>
    <xs:element name="Severity" type="xs:int" nillable="true"/>
    <xs:element name="Time" type="xs:long" nillable="true"/>
  </xs:sequence>
</xs:complexType>

<xs:complexType name="XMLMetaAttrib">
  <xs:sequence>
    <xs:element name="Name" type="xs:string" nillable="true"/>
    <xs:element name="Value" type="xs:string" nillable="true"/>
  </xs:sequence>
</xs:complexType>

<xs:simpleType name="Version">
  <xs:restriction base="xs:string">
    <xs:enumeration value="FCI_VERSION_ONE"/>
    <xs:enumeration value="FCI_VERSION_TWO"/>
  </xs:restriction>
</xs:simpleType>

<xs:simpleType name="ReportType">
  <xs:restriction base="xs:string">

```

```

    <xs:enumeration value="PERIODIC"/>
    <xs:enumeration value="FAULT"/>
    <xs:enumeration value="LOSS_OF_CURRENT_FAULT"/>
    <xs:enumeration value="LOSS_OF_VOLTAGE_FAULT"/>
    <xs:enumeration value="LOSS_OF_CURRENT_AND_VOLTAGE_FAULT"/>
    <xs:enumeration value="TIMEOUT_INTERVAL_EXCEEDED"/>
  </xs:restriction>
</xs:simpleType>

<xs:simpleType name="V2ReportType">
  <xs:restriction base="xs:string">
    <xs:enumeration value="NULL"/>
    <xs:enumeration value="Deployment"/>
    <xs:enumeration value="Periodic"/>
    <xs:enumeration value="Restoration"/>
    <xs:enumeration value="Fault"/>
    <xs:enumeration value="LOSS_OF_CURRENT"/>
    <xs:enumeration value="LOSS_OF_VOLTAGE"/>
    <xs:enumeration value="LOSS_OF_CURRENT_VOLTAGE"/>
    <xs:enumeration value="DOWNLINK_RESPONSE_ACK"/>
    <xs:enumeration value="DOWNLINK_RESPONSE_NEGATIVE_ACK"/>
    <xs:enumeration value="FCI_SOFTWARE_UPGRADE_ACK"/>
    <xs:enumeration value="FCI_SOFTWARE_UPGRADE_NEGATIVE_ACK"/>
    <xs:enumeration value="TIMEOUT_INTERVAL_EXCEEDED"/>
    <xs:enumeration value="Invalid"/>
  </xs:restriction>
</xs:simpleType>

<xs:simpleType name="v2PayloadType">
  <xs:restriction base="xs:string">
    <xs:enumeration value="NULL"/>
    <xs:enumeration value="DEVICE_INFORMATION"/>
    <xs:enumeration value="MOMENTARY_EVENT_COUNTER"/>
    <xs:enumeration value="CUMULATIVE_EVENT_COUNTER"/>
    <xs:enumeration value="FAULT_INFORMATION"/>
    <xs:enumeration value="LOAD_INFORMATION"/>
    <xs:enumeration value="TIMESTAMP"/>
  </xs:restriction>
</xs:simpleType>
</xs:schema>

```

## A.4 KONWPTSdu Schema

```

<?xml version="1.0" encoding="UTF-8" standalone="yes"?>
<xs:schema version="1.0" xmlns:xs="http://www.w3.org/2001/XMLSchema">

  <xs:element name="KONWPTSdu" type="konwptSdu"/>

  <xs:complexType name="konwptSdu">
    <xs:all>
      <xs:element name="AppTypeID" type="xs:int"/>
      <xs:element name="App_Device_Id" type="xs:Long"/>
      <xs:element name="deviceTimestamp" type="xs:Long" minOccurs="0"/>
    </xs:all>
  </xs:complexType>

```



```

    <xs:element name="Message_Id" type="xs:long"/>
    <xs:element name="Failures">
      <xs:complexType>
        <xs:sequence>
          <xs:element name="item" type="FailureType" nillable="true" minOccurs="0"
maxOccurs="unbounded"/>
        </xs:sequence>
      </xs:complexType>
    </xs:element>
    <xs:element name="LowBatteryAlarm" type="xs:boolean"/>
    <xs:element name="messageType" type="messageType"/>
    <xs:element name="Device_Id" type="xs:long"/>
    <xs:element name="overThresholdAlarm" type="xs:boolean"/>
    <xs:element name="pressure" type="xs:double"/>
    <xs:element name="rateOfChangeAlarm" type="xs:boolean"/>
    <xs:element name="Message_Received" type="xs:long"/>
    <xs:element name="sensorFaultAlarm" type="xs:boolean"/>
    <xs:element name="timeAcquisitionError" type="xs:boolean"/>
    <xs:element name="ULP_Node_Id" type="xs:long"/>
    <xs:element name="underThresholdAlarm" type="xs:boolean"/>
    <xs:element name="voltage" type="xs:double"/>
    <xs:element name="MetaAttribs">
      <xs:complexType>
        <xs:sequence>
          <xs:element name="Attrib" type="XMLMetaAttrib" minOccurs="0"
maxOccurs="unbounded"/>
        </xs:sequence>
      </xs:complexType>
    </xs:element>
  </xs:all>
</xs:complexType>

<xs:complexType name="FailureType">
  <xs:sequence>
    <xs:element name="Id" type="xs:int"/>
    <xs:element name="Severity" type="xs:int" nillable="true"/>
    <xs:element name="Time" type="xs:long" nillable="true"/>
  </xs:sequence>
</xs:complexType>

<xs:complexType name="XMLMetaAttrib">
  <xs:sequence>
    <xs:element name="Name" type="xs:string" nillable="true"/>
    <xs:element name="Value" type="xs:string" nillable="true"/>
  </xs:sequence>
</xs:complexType>

<xs:simpleType name="messageType">
  <xs:restriction base="xs:string">
    <xs:enumeration value="Periodic"/>
    <xs:enumeration value="GetDeviceSettings"/>
    <xs:enumeration value="SetDeviceSettings"/>
    <xs:enumeration value="GetDeviceStats"/>
    <xs:enumeration value="ResetALARms"/>
  </xs:restriction>
</xs:simpleType>

```

```

    </xs:restriction>
  </xs:simpleType>
</xs:schema>

```

## A.5 SEL8301ASdu Schema

```

<?xml version="1.0" encoding="UTF-8" standalone="yes"?>
<xs:schema version="1.0" xmlns:xs="http://www.w3.org/2001/XMLSchema">

  <xs:element name="SEL8301APortSdu" type="sel8301APortSdu"/>

  <xs:element name="SEL8301ASdu" type="sel8301ASdu"/>

  <xs:complexType name="sel8301APortSdu">
    <xs:all>
      <xs:element name="armed" type="xs:boolean"/>
      <xs:element name="attachedSensorField" type="xs:int"/>
      <xs:element name="cumulativeFaults" type="xs:int"/>
      <xs:element name="cumulativeLossOfCurrent" type="xs:int"/>
      <xs:element name="cumulativeReserved0" type="xs:int"/>
      <xs:element name="cumulativeReserved1" type="xs:int"/>
      <xs:element name="eventOffset" type="xs:int"/>
      <xs:element name="fault" type="xs:boolean"/>
      <xs:element name="faultInfoCurrent" type="xs:int"/>
      <xs:element name="faultThreshold" type="xs:int"/>
      <xs:element name="flagReserved1" type="xs:boolean"/>
      <xs:element name="flagReserved2" type="xs:int"/>
      <xs:element name="id" type="xs:long"/>
      <xs:element name="loadReserved1" type="xs:int"/>
      <xs:element name="loaddraw" type="xs:string"/>
      <xs:element name="loc" type="xs:boolean"/>
      <xs:element name="momentaryDisturbanceFault" type="xs:int"/>
      <xs:element name="momentaryFaults" type="xs:int"/>
      <xs:element name="momentaryLoadPickUp" type="xs:int"/>
      <xs:element name="momentaryLossOfCurrent" type="xs:int"/>
      <xs:element name="momentaryReserved0" type="xs:int"/>
      <xs:element name="momentaryReserved1" type="xs:int"/>
      <xs:element name="offline" type="xs:boolean"/>
      <xs:element name="isPeak" type="xs:boolean"/>
      <xs:element name="portId" type="xs:int"/>
      <xs:element name="reportTimestamp" type="xs:long"/>
      <xs:element name="sduId" type="xs:long"/>
      <xs:element name="statisticalInterval" type="xs:int"/>
      <xs:element name="nodeId" type="xs:long"/>
    </xs:all>
  </xs:complexType>

  <xs:complexType name="sel8301ASdu">
    <xs:all>
      <xs:element name="AppTypeID" type="xs:int"/>
      <xs:element name="App_Device_Id" type="xs:long"/>
      <xs:element name="batteryVoltage" type="xs:int" nillable="true"/>
      <xs:element name="deviceFlagReserved14" type="xs:boolean"/>
    </xs:all>
  </xs:complexType>

```

```

<xs:element name="deviceFlagReserved15" type="xs:boolean"/>
<xs:element name="deviceFlashError" type="xs:boolean"/>
<xs:element name="deviceId" type="xs:long" nillable="true"/>
<xs:element name="deviceLowBattery" type="xs:boolean"/>
<xs:element name="deviceOutageWarning" type="xs:boolean"/>
<xs:element name="devicePortError" type="xs:boolean"/>
<xs:element name="deviceRamError" type="xs:boolean"/>
<xs:element name="downLinkData" type="xs:base64Binary"/>
<xs:element name="downLinkMessageLength" type="xs:int"/>
<xs:element name="downLinkPayloadLength" type="xs:int"/>
<xs:element name="downLinkReserved" type="xs:int"/>
<xs:element name="downLinkType" type="xs:int"/>
<xs:element name="firmwareVersion" type="xs:string" nillable="true"/>
<xs:element name="Message_Id" type="xs:long"/>
<xs:element name="Failures">
  <xs:complexType>
    <xs:sequence>
      <xs:element name="item" type="FailureType" nillable="true" minOccurs="0"
maxOccurs="unbounded"/>
    </xs:sequence>
  </xs:complexType>
</xs:element>
<xs:element name="milliseconds" type="xs:int" nillable="true"/>
<xs:element name="Device_Id" type="xs:long"/>
<xs:element name="offlinePorts" type="xs:boolean" nillable="true"/>
<xs:element name="packetLength" type="xs:int" nillable="true"/>
<xs:element name="packetType" type="xs:int" nillable="true"/>
<xs:element name="payloadPacketCount" type="xs:int" nillable="true"/>
<xs:element name="port" type="sel8301APortSdu" minOccurs="0"
maxOccurs="unbounded"/>
<xs:element name="Message_Received" type="xs:long"/>
<xs:element name="reportTimestamp" type="xs:long" nillable="true"/>
<xs:element name="ULP_Node_Id" type="xs:long"/>
<xs:element name="MetaAttribs">
  <xs:complexType>
    <xs:sequence>
      <xs:element name="Attrib" type="XMLMetaAttrib" minOccurs="0"
maxOccurs="unbounded"/>
    </xs:sequence>
  </xs:complexType>
</xs:element>
</xs:all>
</xs:complexType>

<xs:complexType name="FailureType">
  <xs:sequence>
    <xs:element name="Id" type="xs:int"/>
    <xs:element name="Severity" type="xs:int" nillable="true"/>
    <xs:element name="Time" type="xs:long" nillable="true"/>
  </xs:sequence>
</xs:complexType>

<xs:complexType name="XMLMetaAttrib">
  <xs:sequence>

```

```

    <xs:element name="Name" type="xs:string" nillable="true"/>
    <xs:element name="Value" type="xs:string" nillable="true"/>
  </xs:sequence>
</xs:complexType>

<xs:complexType name="position">
  <xs:sequence>
    <xs:element name="column" type="xs:int"/>
    <xs:element name="row" type="xs:int"/>
  </xs:sequence>
</xs:complexType>

<xs:simpleType name="sensorType">
  <xs:restriction base="xs:string">
    <xs:enumeration value="NONE"/>
    <xs:enumeration value="CURRENT_SENSOR"/>
    <xs:enumeration value="DIGITAL_FCI_SENSOR"/>
    <xs:enumeration value="POWER_SENSOR"/>
  </xs:restriction>
</xs:simpleType>
</xs:schema>

```

## A.6 TIQSdu Schema

```

<?xml version="1.0" encoding="UTF-8" standalone="yes"?>
<xs:schema version="1.0" xmlns:xs="http://www.w3.org/2001/XMLSchema">

  <xs:element name="TIQSdu" type="tiqSdu"/>

  <xs:complexType name="Alarm">
    <xs:sequence>
      <xs:element name="Failure" type="xs:string"/>
      <xs:element name="Threshold" type="xs:int"/>
      <xs:element name="Winding" type="xs:int"/>
    </xs:sequence>
  </xs:complexType>

  <xs:complexType name="tiqSdu">
    <xs:all>
      <xs:element name="AppTypeID" type="xs:int"/>
      <xs:element name="AccumulatedPowerKVARWinding1" type="xs:int" nillable="true"/>
      <xs:element name="AccumulatedPowerKVARWinding2" type="xs:int" nillable="true"/>
      <xs:element name="AccumulatedPowerKVARWinding3" type="xs:int" nillable="true"/>
      <xs:element name="AccumulatedPowerKWHWinding1" type="xs:int" nillable="true"/>
      <xs:element name="AccumulatedPowerKWHWinding2" type="xs:int" nillable="true"/>
      <xs:element name="AccumulatedPowerKWHWinding3" type="xs:int" nillable="true"/>
      <xs:element name="Alarms" type="Alarm" maxOccurs="unbounded"/>
      <xs:element name="AmbientTemperature" type="xs:int" nillable="true"/>
      <xs:element name="AmpsWindings1" type="xs:int" nillable="true"/>
      <xs:element name="AmpsWindings2" type="xs:int" nillable="true"/>
      <xs:element name="AmpsWindings3" type="xs:int" nillable="true"/>
      <xs:element name="App_Device_Id" type="xs:long"/>
    </xs:all>
  </xs:complexType>

```

```

<xs:element name="Conductor1Temperature" type="xs:int" nillable="true"/>
<xs:element name="Conductor2Temperature" type="xs:int" nillable="true"/>
<xs:element name="Conductor3Temperature" type="xs:int" nillable="true"/>
<xs:element name="FaultDurationCyclesWinding1" type="xs:int" nillable="true"/>
<xs:element name="FaultDurationCyclesWinding2" type="xs:int" nillable="true"/>
<xs:element name="FaultDurationCyclesWinding3" type="xs:int" nillable="true"/>
<xs:element name="Message_Id" type="xs:Long"/>
<xs:element name="Failures">
  <xs:complexType>
    <xs:sequence>
      <xs:element name="item" type="FailureType" nillable="true" minOccurs="0"
maxOccurs="unbounded"/>
    </xs:sequence>
  </xs:complexType>
</xs:element>
<xs:element name="MaxLoadPercentageWindings1" type="xs:double"
nillable="true"/>
<xs:element name="MaxLoadPercentageWindings2" type="xs:double"
nillable="true"/>
<xs:element name="MaxLoadPercentageWindings3" type="xs:double"
nillable="true"/>
<xs:element name="MaxVoltageSwellWinding1" type="xs:int" nillable="true"/>
<xs:element name="MaxVoltageSwellWinding2" type="xs:int" nillable="true"/>
<xs:element name="MaxVoltageSwellWinding3" type="xs:int" nillable="true"/>
<xs:element name="MinVoltageSagWinding1" type="xs:int" nillable="true"/>
<xs:element name="MinVoltageSagWinding2" type="xs:int" nillable="true"/>
<xs:element name="MinVoltageSagWinding3" type="xs:int" nillable="true"/>
<xs:element name="NeutralAmps" type="xs:int" nillable="true"/>
<xs:element name="Device_Id" type="xs:Long"/>
<xs:element name="PowerFactorWindings1" type="xs:double" nillable="true"/>
<xs:element name="PowerFactorWindings2" type="xs:double" nillable="true"/>
<xs:element name="PowerFactorWindings3" type="xs:double" nillable="true"/>
<xs:element name="Message_Received" type="xs:Long"/>
<xs:element name="TopOil1Temperature" type="xs:int" nillable="true"/>
<xs:element name="TopOil2Temperature" type="xs:int" nillable="true"/>
<xs:element name="TopOil3Temperature" type="xs:int" nillable="true"/>
<xs:element name="Transformer_Id" type="xs:int"/>
<xs:element name="ULP_Node_Id" type="xs:Long"/>
<xs:element name="Winding1FaultMagnitude" type="xs:int" nillable="true"/>
<xs:element name="Winding1HotSpot" type="xs:int" nillable="true"/>
<xs:element name="Winding2FaultMagnitude" type="xs:int" nillable="true"/>
<xs:element name="Winding2HotSpot" type="xs:int" nillable="true"/>
<xs:element name="Winding3FaultMagnitude" type="xs:int" nillable="true"/>
<xs:element name="Winding3HotSpot" type="xs:int" nillable="true"/>
<xs:element name="Windings1FltMagExceed" type="xs:boolean" nillable="true"/>
<xs:element name="Windings1Voltage" type="xs:int" nillable="true"/>
<xs:element name="Windings2FltMagExceed" type="xs:boolean" nillable="true"/>
<xs:element name="Windings2Voltage" type="xs:int" nillable="true"/>
<xs:element name="Windings3FltMagExceed" type="xs:boolean" nillable="true"/>
<xs:element name="Windings3Voltage" type="xs:int" nillable="true"/>
<xs:element name="MetaAttribs">
  <xs:complexType>
    <xs:sequence>

```

```

        <xs:element name="Attrib" type="XMLMetaAttrib" minOccurs="0"
maxOccurs="unbounded"/>
      </xs:sequence>
    </xs:complexType>
  </xs:element>
</xs:all>
</xs:complexType>

<xs:complexType name="FailureType">
  <xs:sequence>
    <xs:element name="Id" type="xs:int"/>
    <xs:element name="Severity" type="xs:int" nillable="true"/>
    <xs:element name="Time" type="xs:long" nillable="true"/>
  </xs:sequence>
</xs:complexType>

<xs:complexType name="XMLMetaAttrib">
  <xs:sequence>
    <xs:element name="Name" type="xs:string" nillable="true"/>
    <xs:element name="Value" type="xs:string" nillable="true"/>
  </xs:sequence>
</xs:complexType>
</xs:schema>

```

## A.7 ElectricAMISdu Schema

```

<?xml version="1.0" encoding="UTF-8" standalone="yes"?>
<xs:schema version="1.0" xmlns:xs="http://www.w3.org/2001/XMLSchema">

  <xs:element name="ElectricAMIEventsSdu" type="ElectricAMIEventsSdu"/>

  <xs:element name="ElectricAMIReadingsSdu" type="ElectricAMIReadingsSdu"/>

  <xs:element name="ElectricAMISdu" type="ElectricAMISdu"/>

  <xs:complexType name="ElectricAMIReadingsSdu">
    <xs:all>
      <xs:element name="amiSduId" type="xs:long"/>
      <xs:element name="appDeviceId" type="xs:long"/>
      <xs:element name="delta" type="xs:double" minOccurs="0"/>
      <xs:element name="qualityCode" type="xs:string" minOccurs="0"/>
      <xs:element name="qualityCodeDescription" type="xs:string" minOccurs="0"/>
      <xs:element name="readingDate" type="xs:dateTime" minOccurs="0"/>
      <xs:element name="readingTypeId" type="xs:string" minOccurs="0"/>
      <xs:element name="readingTypeDescription" type="xs:string" minOccurs="0"/>
      <xs:element name="Received" type="xs:dateTime" minOccurs="0"/>
      <xs:element name="ulpNodeId" type="xs:long"/>
      <xs:element name="value" type="xs:double"/>
    </xs:all>
  </xs:complexType>

  <xs:complexType name="parseMessageSummary" abstract="true">
    <xs:sequence/>
  </xs:complexType>

```



```

</xs:complexType>

<xs:complexType name="electricAMISdu">
  <xs:all>
    <xs:element name="AppTypeID" type="xs:int"/>
    <xs:element name="App_Device_Id" type="xs:long"/>
    <xs:element name="Failures">
      <xs:complexType>
        <xs:sequence>
          <xs:element name="item" type="FailureType" nillable="true" minOccurs="0"
maxOccurs="unbounded"/>
        </xs:sequence>
      </xs:complexType>
    </xs:element>
    <xs:element name="messageSummary" type="xs:string" minOccurs="0"/>
    <xs:element name="Device_Id" type="xs:long"/>
    <xs:element name="Message_Received" type="xs:long"/>
    <xs:element name="ULP_Node_Id" type="xs:long"/>
    <xs:element name="UplinkType" type="UplinkType" minOccurs="0"/>
    <xs:element name="MetaAttribs">
      <xs:complexType>
        <xs:sequence>
          <xs:element name="Attrib" type="XMLMetaAttrib" minOccurs="0"
maxOccurs="unbounded"/>
        </xs:sequence>
      </xs:complexType>
    </xs:element>
  </xs:all>
</xs:complexType>

<xs:complexType name="FailureType">
  <xs:sequence>
    <xs:element name="Id" type="xs:int"/>
    <xs:element name="Severity" type="xs:int" nillable="true"/>
    <xs:element name="Time" type="xs:long" nillable="true"/>
  </xs:sequence>
</xs:complexType>

<xs:complexType name="XMLMetaAttrib">
  <xs:sequence>
    <xs:element name="Name" type="xs:string" nillable="true"/>
    <xs:element name="Value" type="xs:string" nillable="true"/>
  </xs:sequence>
</xs:complexType>

<xs:complexType name="electricAMIEventsSdu">
  <xs:all>
    <xs:element name="amiSduId" type="xs:long"/>
    <xs:element name="appDeviceId" type="xs:long"/>
    <xs:element name="categoryCodeId" type="xs:string" minOccurs="0"/>
    <xs:element name="eventDescription" type="xs:string" minOccurs="0"/>
    <xs:element name="failureTypeId" type="xs:int" minOccurs="0"/>
    <xs:element name="occurenceDate" type="xs:dateTime" minOccurs="0"/>
    <xs:element name="Received" type="xs:dateTime" minOccurs="0"/>
  </xs:all>

```

```
    <xs:element name="ulpNodeId" type="xs:long"/>
  </xs:all>
</xs:complexType>

<xs:simpleType name="RequestType">
  <xs:restriction base="xs:string">
    <xs:enumeration value="MDMS_READ"/>
    <xs:enumeration value="MDMS_CONNECT"/>
    <xs:enumeration value="MDMS_DISCONNECT"/>
    <xs:enumeration value="MDMS_CONNECT_STATE"/>
    <xs:enumeration value="MDMS_LOAD_PROFILE"/>
    <xs:enumeration value="MDMS_DEMAND_RESET"/>
    <xs:enumeration value="EMCM_GET_LOGS"/>
    <xs:enumeration value="EMCM_GET_METER_INFO"/>
    <xs:enumeration value="EMCM_RESET_NODE"/>
    <xs:enumeration value="EMCM_RESET EMCME"/>
    <xs:enumeration value="EMCM_RESET_METER"/>
    <xs:enumeration value="EMCM_CLEAR_METER_FLAG"/>
    <xs:enumeration value="EMCM_UPLOAD_MARRIAGE_FILE"/>
    <xs:enumeration value="EMCM_SET_CONFIG_VALUE"/>
  </xs:restriction>
</xs:simpleType>

<xs:simpleType name="UplinkType">
  <xs:restriction base="xs:string">
    <xs:enumeration value="NONE"/>
    <xs:enumeration value="EVENT"/>
    <xs:enumeration value="BULK_READINGS"/>
    <xs:enumeration value="INTERVAL_READINGS"/>
    <xs:enumeration value="METER_INFO"/>
    <xs:enumeration value="RELAY_STATE"/>
  </xs:restriction>
</xs:simpleType>
</xs:schema>
```



# Appendix B Abbreviations and Terms

---

Abbreviation/Term	Definition
OTV	Critical Infrastructure Monitoring Application. The network component that passes data from the Gateway to the associated upstream databases.
FAA	Federal Aviation Administration
FCI	Fault Circuit Indicator
HTTP	Hypertext Transfer Protocol
HTTP GET	Requests a representation of the specified resource. Requests using GET should only retrieve data and should have no other effect.
HTTP POST	Requests that the server accept the entity enclosed in the request as a new subordinate of the resource identified by the URI. The data POSTed might be, for example: <ul style="list-style-type: none"><li>■ An annotation for existing resources</li><li>■ A message for a bulletin board, newsgroup, mailing list, or comment thread</li><li>■ A block of data that is the result of submitting a web form to a data-handling process</li><li>■ An item to add to a database</li></ul>
KONWPT	The wireless pressure transmitter developed by KONČAR that is part of the wireless pipeline pressure monitoring system. The KONWPT is a battery powered autonomous unit for pipeline pressure measurement.
Node	The wireless module developed by On-Ramp Wireless that integrates with OEM sensors and communicates sensor data to an Access Point. Also, the generic term used interchangeably with endpoint device.
Payload	The XML payload is the body data or contents (e.g., the “cargo”) of a data transmission.
REST	Representational State Transfer
SDU	Service Data Unit
SEL	Schweitzer Engineering Laboratories
SSH	Secure Shell
SSL	Secure Socket Layer
TIQ	TransformerIQ
URL	Uniform Resource Locator
XML	Extensible Markup Language