Finanziato dall'Unione europea NextGenerationEU | Ministero dell'Università e della Ricerca | Italiadomani PIANO NAZIONALE DI RIPRESA E RESILIENZA | UNIVERSITÀ DEGLI STUDI DI NAPOLI FEDERICO II

INFRAGRI Project

IT Platform

IoT APIs

INFRAGRI
The Innovation Infrastructure for Agro-Industrial Technologies

Corso Umberto I n. 40, 80138 – Napoli - presso l'Università Federico II

Partita iva, Codice fiscale e iscrizione al Registro delle imprese n. 10325221215

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Paolo Bellabona	Manager Tecnico Scientifico/Infragri	24/03/2025	1.0

Index

1. Introduction

1.1. Scope of the document

This document presents a description of data models that are created based on the FIWARE smart data models to serve the communication between field devices and Infragri Platform.

1.2. References

In the following table are listed out the refences to external documents and contributions.

REFERENCE	DESCRIPTION
https://www.fiware.org/smart-data-models/	Smart Data Models
https://github.com/smart-data-models	Smart Data Models GitHub

1.3. Glossary

TERMINE	DESCRIZIONE
AV	Antares Vision
A	Amperes
V	Voltage
Wh	Watt-hours
L	Liters
cm	Centimeters
m	Meters
hPa	Hectopascals
ppm	Parts Per Million
°C	Celsius Degrees
W/m2	Watts Per Square Metre
lx	Lux
ppb	Parts Per Biilion

µg/m3	Micrograms Per Cubic Meter Air
µS/cm	Micro Siemens per centimeter
mm/day	Millimiters per day
IoT	Internet Of Things

2. SECURITY MEASURES

Ensuring the security and integrity of data is a top priority in our system. We implement multiple layers of protection to safeguard the communication, devices, and data exchanged between the source and the system.

2.1. Data Encryption via HTTPS

All data transmitted between devices, gateways, and our system is encrypted using HTTPS. The HTTPS endpoint is secured with a valid SSL/TLS certificate issued and certified by Infragri, ensuring trusted and encrypted communication channels.

2.2. Authentication and Authorization

Only trusted sources and devices with valid API keys are allowed to connect and send data.

2.3. Device Identity Management

Each IoT device in the Infragri network is uniquely identified and managed, preventing unauthorized devices from communicating with the system.

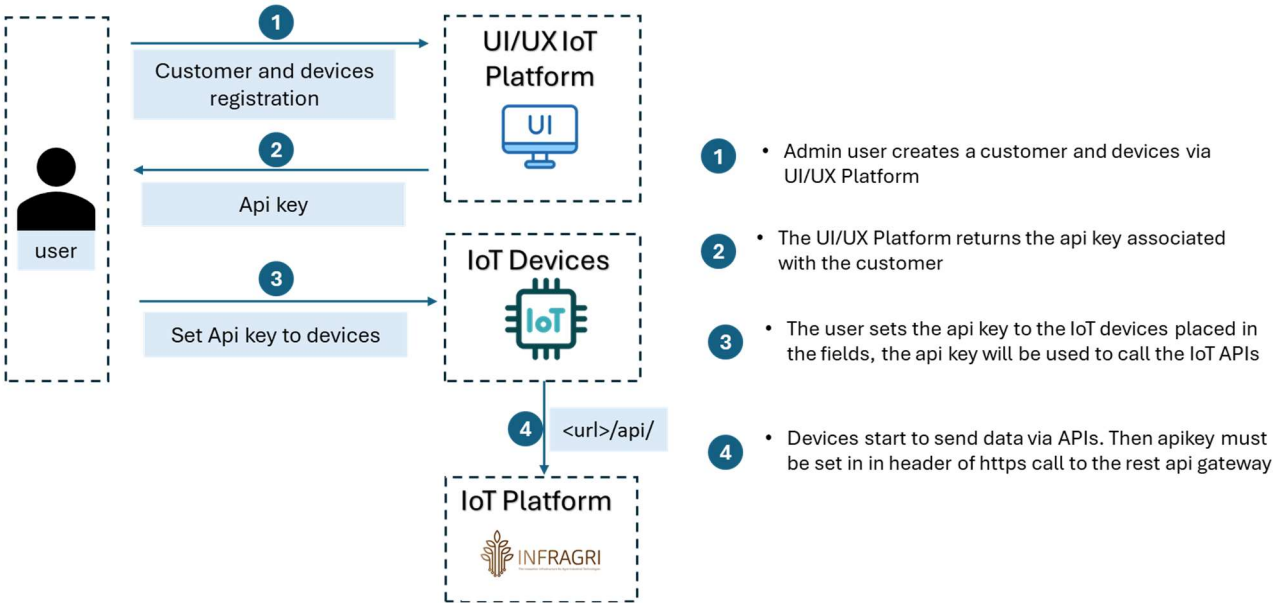
2.4. Regular Security Updates

Our platform is continuously monitored and updated to address emerging security threats, applying patches and improvements as necessary.

2.5. Data Integrity Checks

We perform checks to ensure the accuracy and completeness of the data received, preventing tampering or corruption.

2.6. Flow setup overview



3. ACCESS POINT

Each API part of the integration layer must be consumed adding into the header of the POST message the value of a known and accepted ApiKey, provided by Infragri application.

Two methods for the APIs utilization are available:

- OneByOne Payload
- Multiple Payloads

3.1. OneByOne Payload via RestApi

Accepts a single measurement per request. Use this endpoint when measurements are generated sporadically or individually, such as in real-time scenarios where each measurement must be processed immediately after it is recorded. It is ideal for devices with low measurement frequency or when low-latency processing is required.

3.1.1. Key-Value

For simplified sensor readings.

curl -X POST “<url>/api/Ingest” \

-H “ApiKey:{apikey}” \

-H “Content-Type: application/json” \

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-d 'payload'

3.1.2. Normalized

For more complext sensor readings that need to have additional metadata per property.

curl -X POST "<url>/api/Ingest/normalized" \

-H "ApiKey:{apikey}" \

-H "Content-Type: application/json" \

-d 'payload'

3.2. Multiple Payloads via RestApi

Accepts a list of measurements in a single request. Use this endpoint when multiple measurements can be collected and sent together in bulk. This is suitable for scenarios where the device stores data temporarily (e.g., offline periods) and sends multiple records at once when connectivity is restored. It optimizes network usage and reduces the number of HTTP requests, making it more efficient for devices with higher measurement frequencies or constrained connectivity.

3.2.1. Key-Value

For simplified sensor readings.

curl -X POST "<url>/api/Ingest/list" \

-H "ApiKey:{apikey}" \

-H "Content-Type: application/json" \

-d '[payload]'

3.2.2. Normalized

For more complext sensor readings that need to have additional metadata per property.

curl -X POST "<url>/api/Ingest/list/normalized" \

-H "ApiKey:{apikey}" \

-H "Content-Type: application/json" \

-d '[payload]'

4. RAW DATA MODEL

Here there are listed out all the measures supported by the APIs.

4.1. Main Properties

Below the mapped properties to get data from field devices.

4.1.1. Air Quality Index

Property name	airQualityIndex
Description	The Air Quality Index (AQI) quantifies air pollution on a scale from 0 to 800, indicating the cleanliness or pollution level of the air. It is calculated based on the concentrations of various pollutants and provides essential information for assessing environmental conditions and public health risks.
Type	Number
Minimum	0
Maximum	800

4.1.2. Air Quality Level

Property name	airQualityLevel
Description	A categorical representation of the air quality based on AQI values. It simplifies the interpretation of pollution levels, ranging from 'Good' to 'Hazardous,' to help users quickly understand environmental conditions and take necessary precautions.
Type	Number
Minimum	1
Maximum	6

One of the following values are expected:

- 1 – Good
- 2 – Moderate
- 3 – Unhealthy for sensitive groups
- 4 – Unhealthy
- 5 – Very unhealthy

- 6 – Hazardous

4.1.3. Altitude

Property name	altitude
Description	Specifies the elevation at which the measurement was recorded, measured in meters. Altitude influences various environmental parameters such as temperature, atmospheric pressure, and weather patterns.
Type	number
Minimum	-500
Maximum	9000
Units	m

4.1.4. Atmospheric Pressure

Property name	atmosphericPressure
Description	Represents the pressure exerted by the atmosphere at a specific location, measured in hectopascals (hPa). This parameter is vital for weather prediction and understanding local climate conditions.
Type	number
Minimum	300
Maximum	1100
Units	hPa

4.1.5. Barometric Trend

Property name	barometricTrend
Description	Indicates the recent change in atmospheric pressure. It provides insights into short-term weather shifts, such as approaching storms or clear weather, by showing if the pressure is rising, falling, or steady.
Type	number
Minimum	0
Maximum	2

One of the following values are expected:

- 0 – Rising

- 1 – Falling
- 2 – Steady

4.1.6. Battery Level

Property name	batteryLevel
Description	Shows the remaining battery charge of the device as a percentage, ranging from 0% (empty) to 100% (fully charged). A value of -1 indicates that battery measurement is unavailable. Critical for monitoring power supply in remote or autonomous systems.
Type	number
Minimum	-1
Maximum	100
Units	%

4.1.7. Battery Voltage

Property name	batteryVoltage
Description	Measures the current voltage level of the device's battery in volts (V), providing a direct indication of battery health and operational status.
Type	number
Minimum	0
Maximum	20
Units	V

4.1.8. Cargo Weight

Property name	cargoWeight
Description	Represents the total weight of cargo being transported or stored, measured in kilograms. Important for logistics, inventory management, and safety compliance in transport operations.
Type	number
Minimum	0
Maximum	100000
Units	kg

4.1.9. Cloud Cover

Property name	cloudCover
Description	Indicates the fraction of the sky covered by clouds at the observation location, expressed as a value between 0 (clear sky) and 1 (completely overcast). It helps in analyzing weather conditions and solar radiation levels.
Type	number
Minimum	0
Maximum	1

4.1.10. Carbon Monoxide

Property name	co
Description	Indicates the concentration of carbon monoxide (CO) in the air, measured in parts per million (ppm). CO levels are critical for air quality monitoring due to the gas's harmful effects on human health.
Type	number
Minimum	0
Maximum	1000
Units	ppm

4.1.11. Carbon Dioxide

Property name	co2
Description	Reflects the concentration of carbon dioxide (CO2) in the atmosphere, measured in parts per million (ppm). CO2 levels are monitored for environmental studies, greenhouse gas analysis, and indoor air quality management.
Type	number
Minimum	0
Maximum	5000
Units	ppm

4.1.12. Cumulative Rainfall

Property name	cumulativeRainfall
Description	Measures the total amount of rainfall accumulated over a specific period, expressed in millimeters (mm). It is a key metric for hydrological studies, flood forecasting, and agricultural planning.

Type	number
Minimum	0
Maximum	65535
Units	mm

4.1.13. Current

Property name	current
Description	Captures the electrical current flowing through a circuit, measured in amperes (A). Essential for monitoring the operational load and safety of electrical systems.
Type	number
Minimum	-5
Maximum	10
Units	A

4.1.14. Date Observed

Property name	dateObserved
Description	Captures the exact date and time when the observation or measurement was recorded, following the ISO 8601 date-time format. Essential for timestamping events and ensuring data accuracy.
Type	string
Format	date-time

4.1.15. Depth

Property name	depth
Description	Measures the vertical distance below a reference point (typically the soil surface) at which a measurement, sample, or observation is taken.
Type	number
Minimum	0
Units	cm

4.1.16. Delta T

Property name	deltaT

Description	The difference between dry bulb and wet bulb temperatures. It's an important indicator for spray operations in agriculture as it affects droplet lifetime and drift risk. Delta T is a proxy measure for the evaporation rate and is used to determine optimal conditions for pesticide application..
Type	number
Minimum	0
Maximum	50
Units	°C

4.1.17. Dew Point

Property name	dewPoint
Description	Represents the temperature at which air becomes saturated with moisture and dew forms, measured in degrees Celsius (°C). This parameter helps in evaluating humidity and condensation risk.
Type	number
Minimum	-50
Maximum	80
Units	°C

4.1.18. Diffuse Irradiation

Property name	diffuseIrradiation
Description	Measures the portion of solar irradiance scattered by atmospheric particles, expressed in watts per square meter (W/m2). It is important for solar energy studies and weather modeling.
Type	number
Minimum	0
Maximum	1200
Units	W/m2

4.1.19. Energy

Property name	energy

Description	Indicates the total electrical energy consumed or generated over a period, measured in watt-hours (Wh). Useful for energy management and efficiency monitoring.
Type	number
Minimum	-500
Maximum	500
Units	Wh

4.1.20. Evapotranspiration

Property name	evapotranspiration
Description	The combined process of water evaporation from soil and plant surfaces and transpiration of water through plant tissues. It represents the total water transfer from land to atmosphere and is a critical component of the water cycle. Evapotranspiration is influenced by solar radiation, air temperature, humidity, wind speed, and plant characteristics.
Type	number
Minimum	0
Maximum	50
Units	mm/day

4.1.21. Fertilizer Concentration

Property name	fertilizerConcentration
Description	Reflects the concentration of fertilizer components in the soil, measured in parts per million (ppm). Vital for precision agriculture to ensure optimal crop growth and avoid over-fertilization.
Type	number
Minimum	0
Units	ppm

4.1.22. Filling Level

Property name	fillingLevel

Description	Represents the percentage fullness of a container (e.g., bin, tank, or silo), ranging from 0% (empty) to 100% (full). Essential for inventory management and automated refilling systems.
Type	number
Minimum	0
Maximum	100
Units	%

4.1.23. Global Navigation Satellite System (GNSS) Fix

Property name	gnssFix
Description	Indicates the fix status of GNSS used for determining the device's geographic position, with values ranging from invalid to 3D fix. It ensures accurate location tracking.
Type	number
Minimum	0
Maximum	3

One of:

- 0 – Invalid
- 1 – No Fix
- 2 – Fix 2D
- 3 – Fix 3D

4.1.24. Global Navigation Satellite System (GNSS) Satellites Count

Property name	gnssSatellitesCount
Description	Shows the number of GNSS satellites currently visible to the device. A higher count generally improves location accuracy.
Type	number
Minimum	0
Maximum	32

4.1.25. Heat Index

Property name	heatIndex

Description	Represents the apparent temperature perceived by humans, factoring in both air temperature and relative humidity. Important for assessing heat stress risks.
Type	number
Units	°C

4.1.26. Illuminance

Property name	illuminance
Description	Measures the amount of light falling on a surface, expressed in lux (lx). It is critical for optimizing lighting conditions in indoor and outdoor environments.
Type	number
Minimum	0
Units	lx

4.1.27. Incremental Water Meter

Property name	incrementalWaterMeter
Description	Measures the volume of water flowing through a system incrementally, expressed in liters (L). Useful for tracking water usage in irrigation, industrial, and residential settings.
Type	number
Minimum	0
Maximum	65535
Units	L

4.1.28. Irrigation Wind Speed

Property name	irrigationWindSpeed
Description	Captures wind speed at an irrigation site, measured in meters per second (m/s). Helps in determining the effectiveness and efficiency of irrigation systems.
Type	number
Minimum	0
Maximum	150
Units	m/s

4.1.29. Internal Temperature

Property name	internalTemperature
Description	Indicates the temperature inside the device housing or weather station case, measured in degrees Celsius (°C). Useful for monitoring device operating conditions.
Type	number
Minimum	-60
Maximum	80
Units	°C

4.1.30. Leaf Wetness

Property name	leafWetness
Description	Measures the amount of moisture on leaf surfaces, expressed as a percentage. Critical for disease prediction and irrigation management in agriculture.
Type	number
Minimum	0
Maximum	100
Units	%

4.1.31. Lower Leaf Wetness

Property name	lowerLeafWetness
Description	Captures the moisture level on the lower surface of leaves, which may differ due to less exposure to environmental factors like wind and sunlight.
Type	number
Minimum	0
Maximum	100
Units	%

4.1.32. Location

Property name	location
Description	Provides the geographic coordinates of the measurement location, formatted as a GeoJSON Point object. Essential for mapping and spatial analysis.
Type	object

Properties	type, coordinates
Required properties	type, coordinates

Property name	type
Description	NGSI Entity type. It must be Point.
Type	string
Enum	Point

Property name	coordinates
Description	Array of coordinates. When the type is equal to Point, the first value of the coordinates array indicates the latitude value and the second indicates the longitude value.
Type	array
Array item type	number
Minimum array items	2

4.1.33. Measurement Height

Property name	measurementHeight
Description	Specifies the vertical distance above a defined reference point (e.g., ground level or device base) at which a measurement is taken, expressed centimeters (cm).
Type	number
Minimum	0
Units	cm

4.1.34. Methane Concentration

Property name	methaneConcentration
Description	Measures the concentration of methane (CH4) in the air, expressed in parts per million (ppm). Important for environmental monitoring and safety in industries handling methane.
Type	number

Minimum	0
Units	ppm

4.1.35. Nitric Oxide

Property name	no
Description	Indicates the concentration of nitric oxide (NO) in the air, measured in parts per billion (ppb). It is a key parameter in air quality studies and combustion analysis.
Type	number
Minimum	0
Units	ppb

4.1.36. Nitrogen Dioxide

Property name	no2
Description	Represents the concentration of nitrogen dioxide (NO2) in the air, measured in parts per billion (ppb). NO2 levels are crucial for assessing air pollution and its health impacts.
Type	number
Minimum	0
Units	ppb

4.1.37. Ozone

Property name	o3
Description	Measures the concentration of ozone (O3) in the air, expressed in parts per billion (ppb). Monitoring ozone levels is essential for air quality management and public health.
Type	number
Minimum	0
Units	ppb

4.1.38. Panel Voltage

Property name	panelVoltage
Description	Captures the voltage output of a photovoltaic (solar) panel, measured in volts (V). Useful for assessing the performance of solar power systems.
Type	number

Minimum	0
Maximum	30
Units	V

4.1.39. Particulate Matter 1

Property name	pm1
Description	Indicates the concentration of airborne particulate matter with a diameter less than 1 micron, measured in micrograms per cubic meter (µg/m³). Important for fine particulate air pollution studies.
Type	number
Minimum	0
Units	µg/m3

4.1.40. Particulate Matter 2.5

Property name	pm2_5
Description	Measures the concentration of particulate matter with a diameter less than 2.5 microns, expressed in micrograms per cubic meter (µg/m³). Essential for monitoring fine dust and its health impacts.
Type	number
Minimum	0
Units	µg/m3

4.1.41. Particulate Matter 10

Property name	pm10
Description	Represents the concentration of particulate matter with a diameter less than 10 microns, measured in micrograms per cubic meter (µg/m³). Used for assessing coarse particle pollution levels.
Type	number
Minimum	0
Units	µg/m3

4.1.42. Pollen Count

Property name	pollenCount

Description	Indicates the concentration of pollen grains in the air, measured in grains per cubic meter. Relevant for allergy forecasting and environmental monitoring.
Type	number
Minimum	0
Units	grains/m3

4.1.43. Power Status

Property name	powerStatus
Description	Reflects the current operating mode of the device's power system, such as standby, power-saving, eco, run, or solar mode. Important for energy management and operational efficiency.
Type	number
Minimum	0
Maximum	4

One of:

- 0 – Stand by
- 1 – Power save
- 2 – Eco
- 3 – Run
- 4 – Solar

4.1.44. Precipitation

Property name	precipitation
Description	Measures the amount of rainwater that has fallen over a specific area, expressed in liters per square meter (l/m²). Vital for weather analysis and water resource management.
Type	number
Minimum	0
Units	l/m2

4.1.45. Received Signal Strength Indicator

Property name	rssi

Description	Indicates the strength of the wireless signal received by the device, measured in dBm. Helps assess the quality of wireless communication links.
Type	number
Maximum	0
Units	dBm

4.1.46. Reference Device

Property name	refDevice
Description	A unique identifier referencing the source device, formatted as a URN. Ensures traceability and device-specific data association.
Type	text
Format	“urn:ngsi-ld:{deviceProviderName}:{serialNumer}”

4.1.47. Relative Humidity

Property name	relativeHumidity
Description	Represents the percentage of water vapor present in the air relative to the maximum it can hold at a given temperature. Essential for climate control and comfort assessments.
Type	number
Minimum	0
Maximum	100
Units	%

4.1.48. Relative Rainfall

Property name	relativeRainfall
Description	Indicates the amount of rainfall measured over a defined period, expressed in millimeters (mm). Useful for irrigation planning and flood prediction.
Type	number
Minimum	0
Maximum	100
Units	mm

4.1.49. Serial Number

Property name	serialNumber
Description	A unique identifier assigned by the device manufacturer, used to differentiate individual devices within a system.
Type	text

4.1.50. Sensor Height

Property name	sensorHeight
Description	Indicates the vertical dimension of the sensor's active surface, typically expressed in centimeters (cm).
Type	number
Minimum	0
Units	cm

4.1.51. Snow Depth

Property name	snowDepth
Description	Measures the depth of accumulated snow at the observation site, expressed in centimeters (cm). Important for water resource management and winter maintenance planning.
Type	number
Minimum	0
Units	cm

4.1.52. Sulfur Dioxide

Property name	so2
Description	Indicates the concentration of sulfur dioxide (SO2) in the air, measured in parts per billion (ppb). SO2 monitoring is crucial for air quality assessment and regulatory compliance.
Type	number
Minimum	0
Units	ppb

4.1.53. Soil Moisture

Property name	soilMoisture

Description	Represents the volumetric water content in the soil, expressed as a percentage. Critical for optimizing irrigation and preventing water stress in plants.
Type	number
Minimum	0
Maximum	100
Units	%

4.1.54. Soil Humidity

Property name	soilHumidity
Description	Represents the percentage of humidity present in the soil, measured as a percentage from 0% to 100%..
Type	number
Minimum	0
Maximum	100
Units	%

4.1.55. Soil Salinity

Property name	soilSalinity
Description	Measures the concentration of soluble salts in soil. High soil salinity can negatively impact plant growth by reducing water uptake, causing osmotic stress, and creating ionic toxicity.
Type	number
Minimum	0
Maximum	50000
Units	µS/cm

4.1.56. Soil PH

Property name	soilPH
Description	Measures the acidity or alkalinity of the soil on a pH scale ranging from 0 to 14. Essential for understanding soil health and suitability for various crops.
Type	number
Minimum	0

Maximum	14
Units	pH

4.1.57. Soil Temperature

Property name	soilTemperature
Description	Indicates the temperature of the soil at a specific depth, measured in degrees Celsius (°C). Useful for crop management and soil biology studies.
Type	number
Minimum	-10
Maximum	50
Units	°C

4.1.58. Solar Radiation

Property name	solarRadiation
Description	Measures the amount of solar energy received per unit area, expressed in watts per square meter (W/m2). Key for solar power analysis and climate studies.
Type	number
Minimum	0
Maximum	1200
Units	W/m^2

4.1.59. Solenoid Status

Property name	solenoidStatus
Description	Monitors the operational state of solenoid valves in irrigation systems, indicating whether sectors are open, closed, or in error.
Type	number
Minimum	0
Maximum	2

One of:

- 0 – Sector closed
- 1 – Sector open

- 2 – Sector in error

4.1.60. Source

Property name	source
Description	Provides the original source of the data as a URL or fully qualified domain name, ensuring transparency and traceability of the data.
Type	string

4.1.61. Stream Gauge

Property name	streamGauge
Description	Measures the elevation of the water surface at a specific location, expressed in centimeters (cm). Essential for hydrological studies and flood monitoring.
Type	number
Minimum	0
Units	cm

4.1.62. Temperature

Property name	temperature
Description	Indicates the ambient temperature at the measurement site, measured in degrees Celsius (°C). Fundamental for weather observation and environmental analysis.
Type	number
Minimum	-60
Maximum	80
Units	°C

4.1.63. Type

Property name	type
Description	Defines the NGSI Entity type of the data payload. Ensures correct classification of the data.
Type	text
Enum	InfragriTelemetryRaw, WeatherObserved, SoilObserved

Available types:

- InfragriTelemetryRaw – represents the entire model defined by Infragri.
- WeatherObserved - represents the weather observed model.
- SoilObserved – represents the soil observed model.

4.1.64. Maximum UV Index

Property name	uVIndexMax
Description	Records the highest UV Index value observed over a specific period, measured on a scale from 1 to 11. Crucial for assessing UV exposure risks.
Type	number
Minimum	1
Maximum	11

4.1.65. Unique device identifier

Property name	uid
Description	A globally unique identifier assigned by the device manufacturer, ensuring unique recognition of each device in the system.
Type	string

4.1.66. Upper Leaf Wetness

Property name	upperLeafWetness
Description	Measures the moisture level on the upper surfaces of leaves, which are more directly exposed to environmental factors like rain and irrigation.
Type	number
Minimum	0
Maximum	100
Units	%

4.1.67. Water Flow Rate

Property name	waterFlowRate
Description	Captures the volume of water flowing through a system per unit of time, measured in liters per second (L/s). Important for water resource management and irrigation control.
Type	number

Minimum	0
Units	L/s

4.1.68. Water Pressure

Property name	waterPressure
Description	The force exerted by water on a unit area.
Type	number
Units	kPa

4.1.69. Wind Direction

Property name	windDirection
Description	Indicates the direction from which the wind is blowing, measured in degrees. A value of -1 signifies no wind. Useful for weather forecasting and agricultural planning.
Type	number
Minimum	-1
Maximum	360
Units	°

4.1.70. Wind Gust

Property name	windGust
Description	Represents brief, sudden increases in wind speed, measured in meters per second (m/s). Important for assessing weather severity and structural safety.
Type	number
Minimum	0
Maximum	150
Units	m/s

4.1.71. Wind Speed

Property name	windSpeed

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Description	Measures the intensity of wind at the observation site, expressed in meters per second (m/s). Essential for weather prediction, energy generation, and agricultural management.
Type	number
Minimum	0
Maximum	150
Units	m/s

4.2. Required Properties

Each data payload needs to contain the following properties:

- Reference Device
  - Functions as a globally unique identifier in URN format.
  - Format follows strict pattern: "urn:ngsi-ld:{deviceProviderName}:{serialNumber}".
  - Combines provider name with device serial number to ensure uniqueness across the entire system.
  - Data type: text with specific formatting requirements
- Date Observed
  - Records the precise timestamp of when a measurement was taken.
  - Must follow ISO 8601 date-time format (e.g., "2023-04-01T14:30:00Z").
  - Data type: string with date-time format.

4.3. Supported data types

The Infragri system supports only the following data types for property values:

- Text – for structured string values, like Date Observed or Reference Device and text-based data like Serial Number.
- Number – for numerical values, measurements, and quantities.
- Object – applies only to custom properties and location in case of key-value model type.

4.3.1. Objects in key-value model

In key-value models there are few available object models:

- Location, with properties:
  - Type – should be value “Point”
- Custom object
  - Type - should be value "Object”

4.3.2. Objects in normalized model

In normalized models, all properties are object models. Type attribute in each property represents the data type of provided value.

4.4. Custom Property

If the device provider contains some properties that are not defined in the set of known properties, it is possible to add more as custom objects to the payload, as in the following example. The custom object should contain metadata that will describe the value in more detail.

```
{
  "customPropertyName": {
    "type": "Object",
    "value": “12.8”,
    "metadata": {
      "unit": "V",
```

4.5. Examples

4.5.1. InfragriTelemetryRaw normalized example


```
{
 "atmosphericPressure": {
  "type": "Number",
  "value": 938.9,
  "unit": "hPa"
 },
 "dateObserved": {
  "type": "DateTime",
  "value": "2024-11-30T07:00:00.00Z"
 },
 "location": {
  "type": "geo:json",
  "value": {
   "type": "Point",
   "coordinates": [41.902782,12.496366]
  }
 },
 "refDevice": {
  "type": "Text",
  "value": "urn:ngsi-ld: DeviceProviderName:serial-number "
 },
 "relativeHumidity": {
  "type": "Number",
  "value": 15,
  "unit": "%"
 },
 "temperature": {
  "type": "Number",
  "value": 3.3,
  "unit": "°C"
 },
 "windDirection": {
  "type": "Number",
  "value": 135,
  "unit": "°"
 },
 "windSpeed": {
  "type": "Number",
  "value": 150,
  "unit": "m/s"
 }
}
```

4.5.2. InfragriTelemetryRaw Key-Value Example


```
{
  "atmosphericPressure": 938.9,
  "dateObserved": "2024-11-30T07:00:00.00Z",
  "location": {
    "type": "Point",
    "coordinates": [41.902782,12.496366]
  },
  "refDevice": "urn:ngsi-ld:DeviceProviderName:serial-number ",
  "relativeHumidity": 62,
  "temperature": 3.3,
  "windDirection": 135,
  "windSpeed": 2,
  “batteryVoltage”: 11.06
}
```

4.5.3. WeatherObserved Key-Value Example


```
{
  "atmosphericPressure": 938.9,
  "dateObserved": "2024-11-30T07:00:00.00Z",
  "location": {
    "type": "Point",
    "coordinates": [41.902782,12.496366]
  },
  "refDevice": "urn:ngsi-ld:DeviceProviderName:serial-number ",
  "relativeHumidity": 62,
  "temperature": 3.3,
  "windDirection": 135,
  "windSpeed": 2,
  "batteryVoltage": 11.06
}
```

4.5.4. SoilObserved Key-Value Example


```
{
  "dateObserved": "2024-11-30T07:00:00.00Z",
  "location": {
    "type": "Point",
    "coordinates": [41.902782,12.496366]
  },
  "refDevice": "urn:ngsi-ld:DeviceProviderName:serial-number ",
  "depth": 20,
  "soilTemperature": 3.3,
  "soilMoisture": 13.09,
  "soilSalinity": 34240,
  "batteryVoltage": 11.06
}
```

4.5.5. Multiple identical sensors


```
{
    "refDevice": "urn:ngsi-ld:DeviceProviderName:serialNumber",
    "dateObserved": "2024-11-30T07:00:00.00Z",
    "windSpeed": 18,
    "measurementHeight": 2
  },
  {
    "refDevice": "urn:ngsi-ld:DeviceProviderName:serialNumber",
    "dateObserved": "2024-11-30T07:00:00.00Z",
    "windSpeed": 20,
    "measurementHeight": 4
  },
  {
    "refDevice": "urn:ngsi-ld:DeviceProviderName:serialNumber",
    "dateObserved": "2024-11-30T07:00:00.00Z",
    "precipitation": 10,
    "leafWetness": 20,
    "temperature": 23,
    "relativeHumidity": 63,
    "solarRadiation": 200,
    "location": {
      "type": "Point",
      "coordates": [41.902782,12.496366]
    }
  }
```

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5. Data Model Validation

Every measurement (payload request) will be validated as in the following figure 1. The process of payload validation is performed in maximum 7 steps.

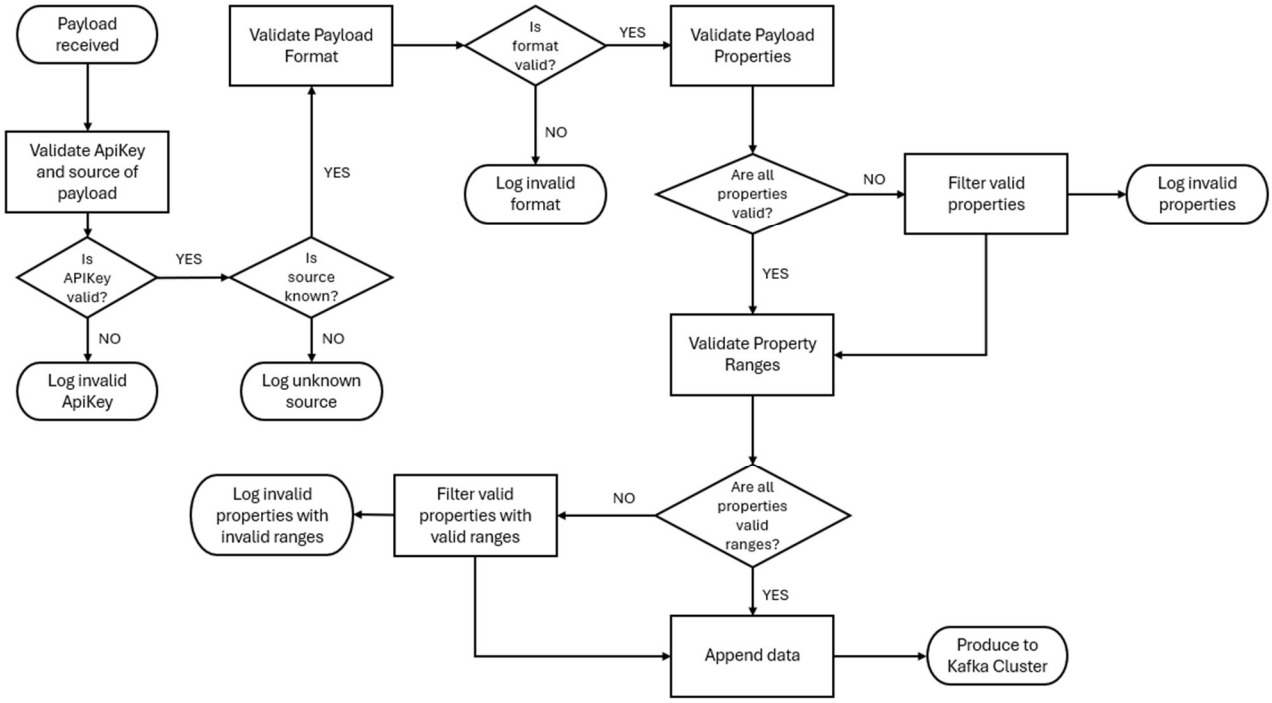

Figure 1 - Payload Validation

5.1. Validation Step 1 – ApiKey and source

The system will check if an ApiKey is provided in the header of the request. If the ApiKey is present, it will be validated. Additionally, the source of the request will be validated by checking the visibility of the source in our system. If either parameter is invalid, the payload measurement will not proceed further, and the system will log it as an error.

5.2. Validation Step 2 – Payload format

The next step is to validate whether the payload is in the correct, predefined format. If the format of the request does not match one of the accepted formats, the payload measurement will not proceed further, and the system will log it as an error.

5.3. Validation Step 3 – Properties

The next step is to validate all the properties of the payload. If all properties are recognized by the system and contain all the required fields, the payload will proceed to Step 5; otherwise, it will proceed to Step 4.

5.4. Validation Step 4 – Filter valid properties

In this step, each property that is not valid—meaning, not recognized by the system—will be discarded from the payload and logged. The filtered properties will then proceed to the next step.

5.5. Validation Step 5 – Property ranges

In this step, the system will validate the value of each property and check whether the value falls within the acceptable range defined by the system. If all properties are within valid ranges, the payload measurement will proceed to Step 6; otherwise, it will proceed to the last step, Step 7.

5.6. Validation Step 6 – Filter valid property ranges

As defined in Step 4, this step will filter out all properties with acceptable ranges, and those that are not will be discarded and logged as errors. The filtered properties will then proceed to Step 7.

5.7. Validation Step 7 – Append data

In this step, the payload is validated, and the system will generate a UTC timestamp indicating when the measurement was received from the data provider to Infragri system. In addition to the timestamp, the system will append a unique identifier as a separate dedicated property, with name deviceId, produced by the Infragri platform for the corresponding device entity.