Recommendation

ITU-T Q.5028 (12/2023)

SERIES Q: Switching and signalling, and associated measurements and tests

Signalling requirements and protocols for IMT-2020 – Protocols for IMT-2020

Data management interfaces for intelligent edge computing-based smart agriculture service

ITU-T Q-SERIES RECOMMENDATIONS

Switching and signalling, and associated measurements and tests

For further details, please refer to the list of ITU-T Recommendations.

Recommendation ITU-T Q.5028

Data management interfaces for intelligent edge computing-based smart agriculture service

Summary

Recommendation ITU-T Q.5028 provides an overview of the intelligent edge computing-based smart agriculture service and specifies its data management interfaces, including network function interfaces and data processing interfaces.

History [*]

Edition	Recommendation	Approval	Study Group	Unique ID
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Keywords

Agriculture, data management, edge.

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FOREWORD

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Recommendation ITU-T Q.5028

Data management interfaces for intelligent edge computing-based smart agriculture service

1 Scope

This Recommendation addresses data management interfaces for intelligent edge computing-based smart agriculture service including the following:

– Overview of the intelligent edge computing-based smart agriculture service;

– Data management interfaces for the intelligent edge computing-based smart agriculture service.

2 References

The following ITU-T Recommendations and other references contain provisions which, through reference in this text, constitute provisions of this Recommendation. At the time of publication, the editions indicated were valid. All Recommendations and other references are subject to revision; users of this Recommendation are therefore encouraged to investigate the possibility of applying the most recent edition of the Recommendations and other references listed below. A list of the currently valid ITU-T Recommendations is regularly published. The reference to a document within this Recommendation does not give it, as a stand-alone document, the status of a Recommendation.

[ITU-T Q.5001]   Recommendation ITU-T Q.5001 (2018), *Signalling requirements and architecture of intelligent edge computing*.

[IETF RFC 7159]   IETF RFC 7159 (2014), *The JavaScript Object Notation (JSON) Data Interchange Format*.

3 Definitions

None.

4 Abbreviations and acronyms

This Recommendation uses the following abbreviations:

AI   Artificial Intelligence

API   Application Programming Interface

EC   Electrical Conductivity

IEC   Intelligent Edge Computing

JSON   JavaScript object notation

pH   Potential of Hydrogen

5 Conventions

Resource elements in clause 7.1 and the fields of the messages in clause 7.2 are encoded in JavaScript object notation (JSON) [IETF RFC 7159].

The grammar used in representing objects defined in this Recommendation is as follows:

– "STRING" and "NUMBER" types are used to indicate string and number, respectively;

–	An array of collective values are enclosed in brackets "[ ]" with values separated by commas "," ;

–	Selective options are separated by a vertical bar " | ";

–	"MIN" means minimum value, while "MAX" means maximum value.

## 6	Introduction

Smart agriculture has improved productivity by controlling the growing environment of crops and analysing data collected during crop growth. Recently, the demand for data-based smart agriculture services has been increasing, as the importance of converged agricultural services (farm autonomous control, pest control, etc.) based on big data is emphasized. Accordingly, the data generated and consumed by Internet of things devices in the smart agriculture have been increasing exponentially.

With the development of data and artificial intelligence (AI) technologies, it has become clear that smart agriculture could benefit from the edge-cloud platform service, which provides a low-delay service from edge servers, and a powerful computational service from cloud servers. Figure 6-1 shows the concept of edge-based smart agriculture service.

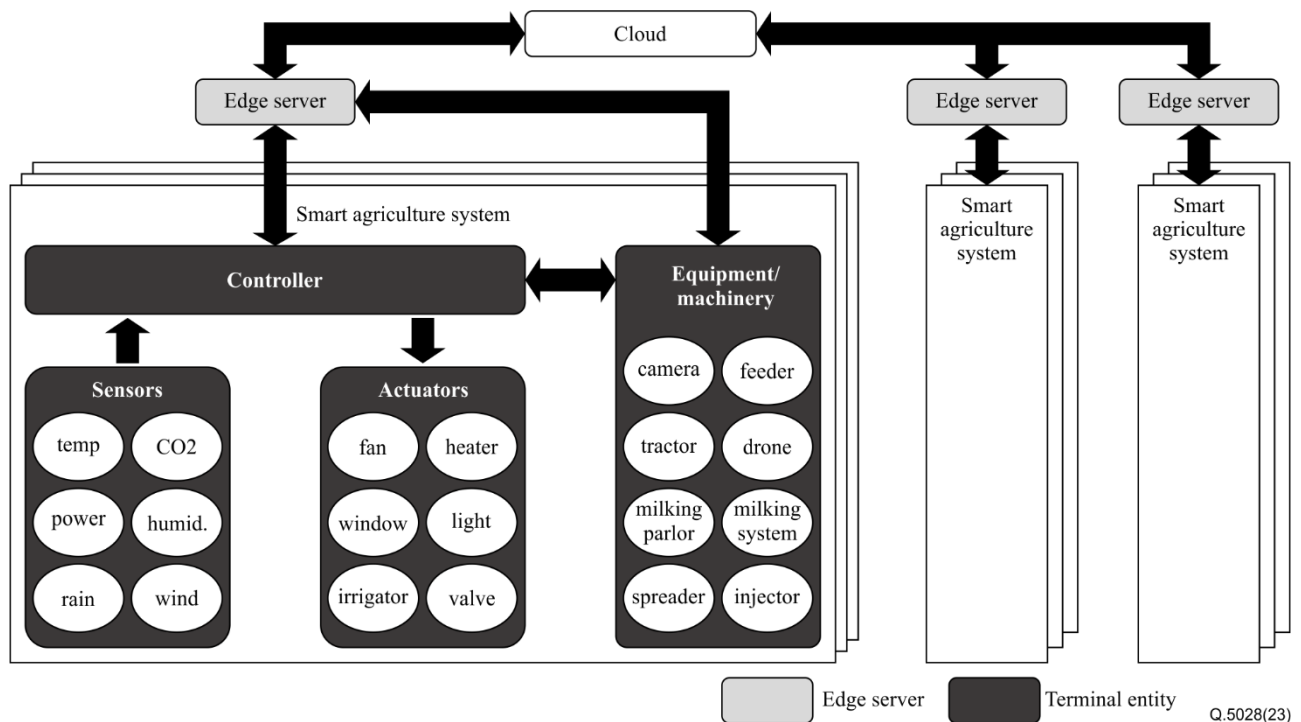**Figure 6-1 – Concept of edge-based smart agriculture service**

As the well-defined edge-cloud infrastructure, the intelligent edge computing (IEC) architecture [ITU-T Q.5001] defines signalling architecture and reference points. Figure 6-2 highlights the reference points used in this Recommendation. This Recommendation defines data management application programming interfaces (APIs) for IEC-based smart agriculture.
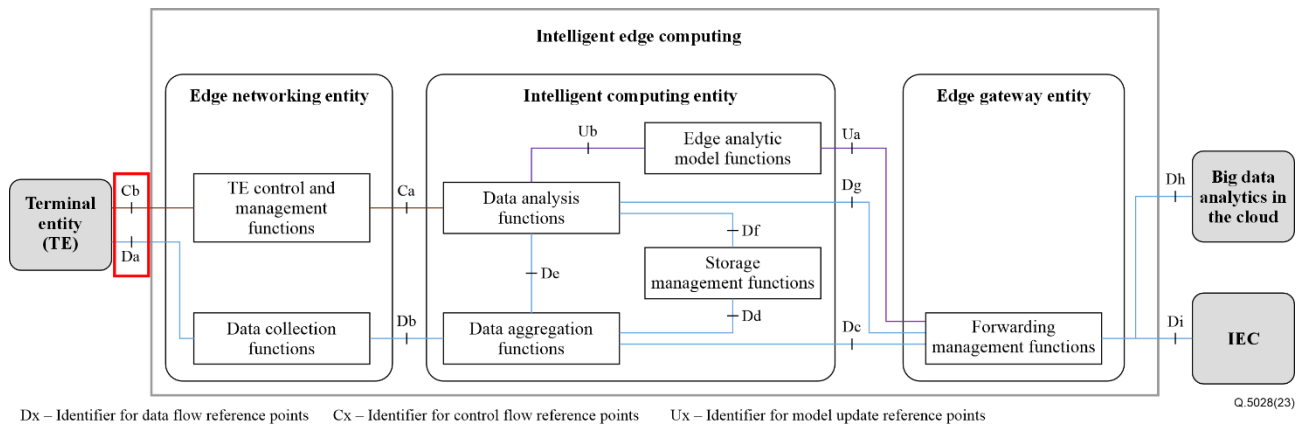
Figure 6-2 – Reference points of IEC [ITU-T Q.5001] used in this Recommendation

7 Data management interfaces for intelligent edge computing-based smart agriculture service

For extensibility, APIs follow representational state transfer (REST) architecture [b-REST] and payloads are encoded in JavaScript object notation (JSON) [IETF RFC 7159].

7.1 Interfaces for network functions

The interfaces for network functions conform to [ITU-T Q.5001].

7.2 Data resources

7.2.1 Temperature

Temperature is an essential data attribute for growing crops. Table 7-1 shows information describing temperature data.

Table 7-1 – Temperature data resource element

Keyword	Type	Description
temperature-value	NUMBER	*temperature-value* is a value indicating the temperature. It is measured by the temperature sensor.
temperature-units	STRING	*temperature-units* indicates the unit of the temperature value. The unit may be represented by 'C' indicating Celsius, 'F' indicating Fahrenheit, and 'K' indicating absolute temperature.
temperature-range	NUMBER (MIN, MAX)	*temperature-range* indicates effective range of temperature values. By specifying an effective range of temperature, unnecessary data collection and transmission can be avoided.
temperature-precision	NUMBER	*temperature-precision* indicates precision of the temperature value. It can be used in conjunction with '*temperature-range*'. For example, if '*temperature-range*' is (0, 10) and '*temperature-precision*' is 1, valid temperature data can be expressed as an integer.

Table 7-1 – Temperature data resource element

Keyword	Type	Description
temperature-margin	NUMBER	*temperature-margin* indicates the error range of the temperature value. It can be used in conjunction with '*temperature-range*'. For example, if '*temperature-range*' is (0, 10) and '*temperature-margin*' is 2, the range of valid measurements may be (−2, 12).

7.2.2 Humidity

As temperature, humidity is an essential data attribute for growing crops. Table 7-2 shows information describing humidity data.

Table 7-2 – Humidity data resource element

Keyword	Type	Description
humidity-value	NUMBER	*humidity-value* is a value indicating the humidity. It is measured by the humidity sensor.
humidity-units	STRING	*humidity-units* indicates the unit of the humidity value. The unit may be represented by '%'.
humidity-range	NUMBER (MIN, MAX)	*humidity-range* indicates effective range of humidity values. By specifying an effective range of humidity, unnecessary data collection and transmission can be avoided.
humidity-precision	NUMBER	*humidity-precision* indicates precision of the humidity value. It can be used in conjunction with '*humidity-range*'. For example, if '*humidity-range*' is (0, 10) and '*humidity-precision*' is 1, valid humidity data can be expressed as an integer from 1 to 9.
humidity-margin	NUMBER	*humidity-margin* indicates the error range of the humidity value. It can be used in conjunction with '*humidity-range*'. For example, if '*humidity-range*' is (0, 10) and '*humidity-margin*' is 2, the range of valid measurements may be (−2, 12).

7.2.3 Carbon dioxide

Carbon dioxide (CO_2) is a data attribute highly related to the photosynthesis of crops. Table 7-3 shows information describing carbon dioxide data.

Table 7-3 – Carbon dioxide data resource element

Keyword	Type	Description
carbon-dioxide-value	NUMBER	*carbon-dioxide-value* is a value indicating the carbon dioxide. It is measured by the carbon dioxide sensor.
carbon-dioxide-units	STRING	*carbon-dioxide-units* indicates the unit of the carbon dioxide value. The unit may be represented by 'ppm'.

Table 7-3 – Carbon dioxide data resource element

Keyword	Type	Description
carbon-dioxide-range	NUMBER (MIN, MAX)	*carbon-dioxide-range* indicates effective range of carbon dioxide values. By specifying an effective range of carbon dioxide, unnecessary data collection and transmission can be avoided.
carbon-dioxide-precision	NUMBER	*carbon-dioxide-precision* indicates precision of the carbon dioxide value. It can be used in conjunction with '*carbon-dioxide-range*'. For example, if '*carbon-dioxide-range*' is (0, 10) and '*carbon-dioxide-precision*' is 1, valid carbon dioxide data can be expressed as an integer from 1 to 9.
carbon-dioxide-margin	NUMBER	*carbon-dioxide-margin* indicates the error range of the carbon dioxide value. It can be used in conjunction with '*carbon-dioxide-range*'. For example, if '*carbon-dioxide-range*' is (0, 10) and '*carbon-dioxide-margin*' is 2, the range of valid measurements may be (-2, 12).

7.2.4   Insolation

Insolation can be used to presume the amount of crop's photosynthesis. Table 7-4 shows information describing insolation data.

Table 7-4 – Insolation data resource element

Keyword	Type	Description
insolation-value	NUMBER	*insolation-value* is a value indicating the insolation. It is measured by the insolation sensor.
insolation-units	STRING	*insolation-units* indicates the unit of the insolation value. The unit may be represented by one of the following: 'W/㎡', 'kcal/m2', 'cal/cm^2/min', or 'ly/min'.
insolation-range	NUMBER (MIN, MAX)	*insolation-range* indicates effective range of insolation values. By specifying an effective range of insolation, unnecessary data collection and transmission can be avoided.
insolation-precision	NUMBER	*insolation-precision* indicates precision of the insolation value. It can be used in conjunction with '*insolation-range*'. For example, if ' *insolation-range*' is (0, 10) and '*insolation-precision*' is 1, valid insolation data can be expressed as an integer from 1 to 9.
insolation-margin	NUMBER	*insolation-margin* indicates the error range of the insolation value. It can be used in conjunction with '*insolation-range*'. For example, if '*insolation-range*' is (0, 10) and '*insolation-margin*' is 2, the range of valid measurements may be (-2, 12).

7.2.5 Wind direction

Wind direction is the direction in which the air is blowing. Table 7-5 shows information describing wind direction data.

Table 7-5 – Wind direction data resource element

Keyword	Type	Description
wind-direction-value	NUMBER	*wind-direction-value* is a value indicating the wind direction. It is measured by the wind direction sensor.
wind-direction-units	STRING	*wind-direction-units* indicates the unit of the wind direction value. The unit may be represented by 360 degrees clockwise. For example, wind direction may be represented 360 degrees for north, 90 degrees for east, 180 degrees for south, and 270 degrees for west
wind-direction-range	NUMBER (MIN, MAX)	*wind-direction-range* indicates effective range of wind direction values. By specifying an effective range of wind direction, unnecessary data collection and transmission can be avoided.
wind-direction-precision	NUMBER	*wind-direction-precision* indicates precision of the wind direction value. It can be used in conjunction with '*wind-direction-range*'. For example, if '*wind-direction-range*' is (0, 10) and '*wind-direction-precision*' is 1, valid wind direction data can be expressed as an integer from 1 to 9.
wind-direction-margin	NUMBER	*wind-direction-margin* indicates the error range of the wind direction value. It can be used in conjunction with '*wind-direction-range*'. For example, if ' *wind-direction-range*' is (0, 10) and '*wind-direction-margin*' is 2, the range of valid measurements may be $(-2, 12)$.

7.2.6 Wind speed

Wind speed is the speed at which the air is blowing. Table 7-6 shows information describing wind speed data.

Table 7-6 – Wind speed data resource element

Keyword	Type	Description
wind-speed-value	NUMBER	*wind-speed-value* is a value indicating the wind speed. It is measured by the wind speed sensor.
wind-speed-units	STRING	*wind-speed-units* indicates the unit of the wind speed value. The unit may be represented by 'm/s' or 'Knot'.
wind-speed-range	NUMBER (MIN, MAX)	*wind-speed-range* indicates effective range of wind speed values. By specifying an effective range of wind speed, unnecessary data collection and transmission can be avoided.
wind-speed-precision	NUMBER	*wind-speed-precision* indicates precision of the wind speed value. It can be used in conjunction

Table 7-6 – Wind speed data resource element

Keyword	Type	Description
		with '*wind-speed-range*'. For example, if '*wind-speed-range*' is (0, 10) and '*wind-speed-precision*' is 1, valid wind speed data can be expressed as an integer from 1 to 9.
wind-speed-margin	NUMBER	*wind-speed-margin* indicates the error range of the wind speed value. It can be used in conjunction with '*wind-speed-range*'. For example, if '*wind-speed-range*' is (0, 10) and '*wind-speed-margin*' is 2, the range of valid measurements may be (−2, 12).

7.2.7   Rain detection

Rain detection indicates whether precipitation events such as rainfall or snowfall have taken place. Table 7-7 shows information describing rain detection data.

Table 7-7 – Rain detection data resource element

Keyword	Type	Description
rain-detection-value	NUMBER	*rain-detection-value* is a value indicating whether rain is detected. It is measured by the rain detection sensor.

7.2.8   Soil moisture tension

Soil moisture tension presents the degree of moisture absorption of the soil. Table 7-8 shows information describing soil moisture tension data.

Table 7-8 – Soil moisture tension data resource element

Keyword	Type	Description
soil-moisture-tension-value	NUMBER	*soil-moisture-tension-value* is a value indicating the soil moisture tension. It is measured by the soil moisture tension sensor.
soil-moisture-tension-units	STRING	*soil-moisture-tension-units* indicates the unit of the soil moisture tension value. The unit may be represented by 'kPA' or 'PA'.
soil-moisture-tension-range	NUMBER (MIN, MAX)	*soil-moisture-tension-range* indicates the effective range of soil moisture tension values. By specifying an effective range of soil moisture tension, unnecessary data collection and transmission can be avoided.
soil-moisture-tension-precision	NUMBER	*soil-moisture-tension-precision* indicates precision of the soil moisture tension value. It can be used in conjunction with '*soil-moisture-tension-range*'. For example, if '*soil-moisture-tension-range*' is (0, 10) and '*soil-moisture-tension-precision*' is 1, valid soil moisture tension data can be expressed as an integer from 1 to 9.

Table 7-8 – Soil moisture tension data resource element

Keyword	Type	Description
soil-moisture-tension-margin	NUMBER	*soil-moisture-tension-margin* indicates the error range of the soil moisture tension value. It can be used in conjunction with '*soil-moisture-tension-range*'. For example, if '*soil-moisture-tension-range*' is (0, 10) and '*soil-moisture-tension-margin*' is 2, the range of valid measurements may be (−2, 12).

7.2.9 Electrical conductivity

Electrical conductivity (EC) indicates a measure of a material's ability to carry an electrical current. Table 7-9 shows information describing electrical conductivity data.

Table 7-9 – Electrical conductivity data resource element

Keyword	Type	Description
electrical-conductivity-value	NUMBER	*electrical-conductivity-value* is a value indicating the electrical conductivity. It is measured by the electrical conductivity sensor.
electrical-conductivity-units	STRING	*electrical-conductivity-units* indicates the unit of the electrical conductivity value. The unit may be represented by 'mS/cm' or 'dS/m'.
electrical-conductivity-range	NUMBER (MIN, MAX)	*electrical-conductivity-range* indicates effective range of electrical conductivity values. By specifying an effective range of electrical conductivity, unnecessary data collection and transmission can be avoided.
electrical-conductivity-precision	NUMBER	*electrical-conductivity-precision* indicates precision of the electrical conductivity value. It can be used in conjunction with '*electrical-conductivity-range*'. For example, if '*electrical-conductivity-range*' is (0, 10) and '*electrical-conductivity-precision*' is 1, valid electrical conductivity data can be expressed as an integer from 1 to 9.
electrical-conductivity-margin	NUMBER	*electrical-conductivity-margin* indicates the error range of the electrical conductivity value. It can be used in conjunction with '*electrical-conductivity-range*'. For example, if '*electrical-conductivity-range*' is (0, 10) and '*electrical-conductivity-margin*' is 2, the range of valid measurements may be (−2, 12).

7.2.10 Potential of hydrogen

Potential of Hydrogen (pH) is a measure of the hydrogen ion concentration in an aqueous solution. Table 7-10 shows information describing potential of hydrogen data.

Table 7-10 – Potential of hydrogen data resource element

Keyword	Type	Description
potential-of-hydrogen-value	NUMBER	*potential-of-hydrogen-value* is a value indicating the potential of hydrogen It is measured by the potential of hydrogen sensor.
potential-of-hydrogen-units	STRING	*potential-of-hydrogen-units* indicates the unit of the potential of hydrogen value. The unit may be represented by 'kPA' or 'PA'.
potential-of-hydrogen-range	NUMBER (MIN, MAX)	*potential-of-hydrogen-range* indicates effective range of potential of hydrogen values. By specifying an effective range of potential of hydrogen, unnecessary data collection and transmission can be avoided.
potential-of-hydrogen-precision	NUMBER	*potential-of-hydrogen-precision* indicates the precision of the potential of hydrogen value. It can be used in conjunction with '*potential-of-hydrogen-range*'. For example, if '*potential-of-hydrogen-range*' is (0, 10) and '*potential-of-hydrogen-precision*' is 1, valid potential of hydrogen data can be expressed as an integer from 1 to 9.
potential-of-hydrogen-margin	NUMBER	*potential-of-hydrogen-margin* indicates the error range of the potential of hydrogen value. It can be used in conjunction with '*potential-of-hydrogen-range*'. For example, if '*potential-of-hydrogen-range*' is (0, 10) and '*potential-of-hydrogen-margin*' is 2, the range of valid measurements may be (−2, 12).

7.2.11 Farm

Farm provides the information of a farm. Table 7-11 shows information describing farm data.

Table 7-11 – Farm data resource element

Keyword	Type	Description
id-of-farm	STRING	*id-of-farm* is a value identifying the farm. *id-of-farm* shall not be modified throughout its lifecycle.
name-of-farm	STRING	*name-of-farm* allows users to intuitively identify the farm.
ctime-of-farm	STRING	*ctime-of-farm* is the time when the farm data is created by registering a farm with smart greenhouse service, and shall not be modified throughout its lifecycle.
mtime-of-farm	STRING	*mtime-of-farm* is the time when the farm data is modified and shall be automatically updated.
address-of-farm	STRING	*address-of-farm* allows users to intuitively identify the farm.
location-of-farm	STRING	*location-of-farm* indicates the geographic location of the farm. The location of a farm is important to identify the farm because geographical location is closely related to the climate conditions affecting

Table 7-11 – Farm data resource element

Keyword	Type	Description
		crop growth. *location-of-farm* can be represented by various types of value such as global navigation satellite system (GNSS) coordinates, and shall include the type of value and unit.
area-of-farm	STRING	*area-of-farm* indicates the area of the farm. *area-of-farm* can be represented by various types of value such as acre or square meter and shall include value, unit and error range.

7.2.12 Greenhouse

Greenhouse provides the information of a smart greenhouse. Table 7-12 shows information describing greenhouse data.

Table 7-12 – Greenhouse data resource element

Keyword	Type	Description
id-of-greenhouse	STRING	*id-of-greenhouse* is a value identifying the greenhouse. *id-of-greenhouse* shall not be modified throughout its lifecycle
name-of-greenhouse	STRING	*name-of-greenhouse* allows users to intuitively identify the greenhouse.
ctime-of-greenhouse	STRING	*ctime-of-greenhouse* is the time when the greenhouse data is created by registering a greenhouse with smart greenhouse service and shall not be modified throughout its lifecycle.
mtime-of-greenhouse	STRING	*mtime-of-greenhouse* is the time when the greenhouse data is modified and shall be automatically updated.
location-of-greenhouse	STRING	*location-of-greenhouse* indicates the geographic location of the greenhouse. *location-of-greenhouse* can be represented by various types of value such as GNSS coordinates and shall include the type of value and unit.
size-of-greenhouse	STRING	*size-of-greenhouse* indicates the width, height and length of the greenhouse. *size-of-greenhouse* can be represented by various types of values such as yard (yd) or meter (m) and shall include value, unit and error range.
type-of-greenhouse	STRING	*type-of-greenhouse* indicates human-readable information about shape, medium, irrigation, heating system, crop, description of cropping season and utilization status of the greenhouse.

7.2.13 Device

Device provides the information of a device that can be installed in a smart greenhouse. Table 7-13 shows information describing device data.

Table 7-13 – Device data resource element

Keyword	Type	Description
id-of-device	STRING	*id-of-device* is a value identifying the device. *id-of-device* shall not be modified throughout its lifecycle.
name-of-device	STRING	*name-of-device* allows users to intuitively identify the device.
ctime-of-device	STRING	*ctime-of-device* is the time when the device data is created by registering a device with smart greenhouse service and shall not be modified throughout its lifecycle.
mtime-of-device	STRING	*mtime-of-device* is the time when the device data is modified and shall be automatically updated.
type-of-device	STRING	*type-of-device* indicates the usage of the device, and multiple device data can have the same type.
model-of-device	STRING	*model-of-device* indicates the model name of the device. Multiple device data can have the same model name.
code-of-device	STRING	*code-of-device* indicates the compatibility of the device. Multiple device data can have the same code.
manufacturer-of-device	STRING	*manufacturer-of-device* indicates human-readable name for easily identifying the manufacturer of the device and includes name, website Internet address, etc.

7.2.14 Device installation

Device installation provides the information about a device installed and operated in a smart greenhouse. A device can be installed at various locations in a smart greenhouse for helping crop growth or collecting environmental status. To control the device or utilize data from the device, it is important to be aware of the information regarding the installation. Table 7-14 shows information describing device installation data.

Table 7-14 – Device installation data resource element

Keyword	Type	Description
id-of-device-install	STRING	*id-of-device-install* is a value identifying the installed device. *id-of-device-install* shall not be modified throughout its lifecycle.
name-of-device-install	STRING	*name-of-device-install* allows users to intuitively identify the installed device.
ctime-of-device-install	STRING	*ctime-of-device-install* is the time when the device installation data is created by registering a device with smart greenhouse service. It shall not be modified throughout its lifecycle.
mtime-of-device-install	STRING	*mtime-of-device-install* is the time when the device installation data is modified. It shall be automatically updated.

Table 7-14 – Device installation data resource element

Keyword	Type	Description
location-of-device-install	STRING	*location-of-device-install* indicates the location of the installed device represented by various types of values such as GNSS coordinates, or an appropriate exchange format regarding GNSS coordinates. It shall include the type of value and unit.
date-of-device-install	STRING	*date-of-device-install* is a value indicating the date of device installation.

7.2.15   User

User provides the information about the user of crop-growth related data. Table 7-15 shows information describing user data.

Table 7-15 – User data resource element

Keyword	Type	Description
id-of-user	STRING	*id-of-user* is a value identifying the user. *id-of-user* shall not be modified throughout its lifecycle.
name-of-user	STRING	*name-of-user* allows users to intuitively identify the user.
ctime-of-user	STRING	*ctime-of-user* is the time when the user data is created by registering a device with smart greenhouse service and shall not be modified throughout its lifecycle.
mtime-of-user	STRING	*mtime-of-user* is the time when the user data is modified and shall be automatically updated.
group-of-user	STRING	*group-of-user* indicates the group to which the user belongs, and includes group identifier, group authority, etc.

7.3   Interfaces for data processing

This clause describes the APIs for data processing including creating, retrieving, updating, and deleting data to be used in the reference point Da specified in [ITU-T Q.5001]. In the body of HTTP request/response message, following notation is used for representing the requirements on the specific parameter.

–   m: mandatory;

–   o: optional;

–   c: conditional meaning that the use of the parameter depends on the context of the message usages.

7.3.1   DataCreation

DataCreation is used for posting data at the edge networking entity. Table 7-16 describes the syntax of the request message.

Table 7-16 – Request message syntax for DataCreation

HTTP Method	POST
HTTP URI	http://[address of edge networking entity]:[port]/[name of smart agriculture service]/[version]/[type of event]/c
BODY	"timestamp" : NUMBER, "device-id" : STRING, "data-id" : NUMBER, "data-type" : "STRING", "data-value": DATA ELEMENT

– *timestamp* field indicates the time when the value is measured. The time when the value measured by the device reaches the system is mainly utilized.

– *device-id* field indicates identifiers of the sensor device that measures the value. It is possible to check which sensor the value was measured through the device identifier. That means the location of the value is measured can be estimated.

– *data-id* field indicates identifiers which is identifying each measurement value.

– *data-type* field indicates what kinds of data, which are defined in clause 7.2.

– *data-value* field indicates data element, which is defined in clauses 7.2.1 to 7.2.10, corresponding data-type.

Table 7-17 describes the syntax of the response for *DataCreation*.

Table 7-17 – Response message syntax for DataCreation

HTTP Response code	*rsp_code*
BODY	None

– *rsp_code* indicates the result of the request. If successful, this is 200, and it uses appropriate HTTP response code if it fails.

7.3.2 DataRetrieval

DataRetrieval is used for retrieving data at the edge networking entity. Table 7-18 describes the syntax of the request message for getting entire data resources.

Table 7-18 – Request message syntax for DataRetrieval for getting entire data resources

HTTP Method	GET
HTTP URI	http://[address of edge networking entity]:[port]/[name of smart agriculture service]/[version]/[type of event]/r/[data-type]
PARAMETERS	"data-type" : STRING

– *data-type* field indicates what kinds of data, which are defined in clause 7.2.

Table 7-19 describes the syntax of the response for *DataRetrieval* for getting specific data resource.

Table 7-19 – Request message syntax for DataRetrieval for Specific Data Resource

HTTP Method	GET
HTTP URI	http://[address of edge networking entity]:[port]/[name of smart agriculture service]/[version]/[type of event]/r/[data-type}/[device-id]
PARAMETERS	"device-id" : STRING, "data-type" : STRING

–   *device-id* field indicates identifiers of the sensor device that measures the data value. It is possible to check which sensor the data value was measured through the device identifier. That means the location where the data value is measured can be estimated.

–   *data-type* field indicates the kinds of data, which are defined in clause 7.2.

Table 7-20 describes the syntax of the response for *DataRetrieval*.

Table 7-20 – Response message syntax for DataRetrieval

HTTP Response code	*rsp_code*
BODY	"timestamp" : NUMBER, "device-id" : STRING, "data-id" : NUMBER, "data-type" : STRING, "data-value": DATA ELEMENT

–   *rsp_code* indicates the result of the request. If successful, this is 200, and it uses appropriate HTTP response code if it fails;

–   *timestamp* field indicates the time when the data value is measured. The time when the data value measured by the device reaches the system is mainly utilized.

–   *device-id* field indicates identifiers of the sensor device that measures data value. It is possible to check which sensor the data value was measured through the device identifier. That means the location of the data value is measured can be estimated.

–   *data-id* field indicates identifiers which is identifying each data value.

–   *data-type* field indicates what kinds of data, which are defined in clause 7.2.

–   *data-value* field indicates data element, which is defined in clauses 7.2.1 to 7.2.10, corresponding to data-type.

7.3.3 DataUpdate

DataUpdate is used for updating data at the edge networking entity. Table 7-21 describes the syntax of the request message.

Table 7-21 – Request message syntax for DataUpdate

HTTP Method	PUT
HTTP URI	`http://[address of edge networking entity]:[port]/[name of smart agriculture service]/[version]/[type of event]/u/[data-id}`
PARAMETERS	"data-id" : NUMBER
BODY	"timestamp" : NUMBER, "data-value": DATA ELEMENT

– *data-id* field indicates identifiers which is identifying each data value.

– *timestamp* field indicates the time when the data value is measured. The time when the data value measured by the device reaches the system is mainly utilized.

– *data-value* field indicates data element, which is only supported for configuration data and defined in clauses 7.2.11 to 7.2.15, corresponding to data-type.

Table 7-22 describes the syntax of the response for *DataUpdate*.

Table 7-22 – Response message syntax for DataUpdate

HTTP Response code	*rsp_code*
BODY	None

– *rsp_code* indicates the result of the request. If successful, this is 200, and it uses appropriate HTTP response code if it fails;

7.3.4 DataDeletion

DataDeletion is used for deleting data at the edge networking entity. Table 7-23 describes the syntax of the request message.

Table 7-23 – Request message syntax for DataDeletion

HTTP Method	POST
HTTP URI	`http://[address of edge networking entity]:[port]/[name of smart agriculture service]/[version]/[type of event]/d/[data-id]`
BODY	"data-id" : NUMBER

– *data-id* field indicates identifiers which is identifying each data value.

Table 7-24 describes the syntax of the response for *DataDeletion*.

Table 7-24 – Response message syntax for DataDeletion

HTTP Response code	*rsp_code*
BODY	None

–   *rsp_code* indicates the result of the request. If successful, this is 200, and it uses appropriate HTTP response code if it fails.

Bibliography

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