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SERIES Y: GLOBAL INFORMATION INFRASTRUCTURE, INTERNET PROTOCOL ASPECTS, NEXT-GENERATION NETWORKS, INTERNET OF THINGS AND SMART CITIES

Internet of things and smart cities and communities – Frameworks, architectures and protocols

Requirements and capability framework of smart utility metering (SUM)

Recommendation ITU-T Y.4419

ITU-T Y-SERIES RECOMMENDATIONS

GLOBAL INFORMATION INFRASTRUCTURE, INTERNET PROTOCOL ASPECTS, NEXT-GENERATION NETWORKS, INTERNET OF THINGS AND SMART CITIES

GLOBAL INFORMATION INFRASTRUCTURE	
General	Y.100–Y.199
Services, applications and middleware	Y.200–Y.299
Network aspects	Y.300–Y.399
Interfaces and protocols	Y.400–Y.499
Numbering, addressing and naming	Y.500–Y.599
Operation, administration and maintenance	Y.600–Y.699
Security	Y.700–Y.799
Performances	Y.800–Y.899
INTERNET PROTOCOL ASPECTS	
General	Y.1000–Y.1099
Services and applications	Y.1100–Y.1199
Architecture, access, network capabilities and resource management	Y.1200–Y.1299
Transport	Y.1300–Y.1399
Interworking	Y.1400–Y.1499
Quality of service and network performance	Y.1500–Y.1599
Signalling	Y.1600–Y.1699
Operation, administration and maintenance	Y.1700–Y.1799
Charging	Y.1800–Y.1899
IPTV over NGN	Y.1900–Y.1999
NEXT GENERATION NETWORKS	
Frameworks and functional architecture models	Y.2000–Y.2099
Quality of Service and performance	Y.2100–Y.2199
Service aspects: Service capabilities and service architecture	Y.2200–Y.2249
Service aspects: Interoperability of services and networks in NGN	Y.2250–Y.2299
Enhancements to NGN	Y.2300–Y.2399
Network management	Y.2400–Y.2499
Computing power networks	Y.2500–Y.2599
Packet-based Networks	Y.2600–Y.2699
Security	Y.2700–Y.2799
Generalized mobility	Y.2800–Y.2899
Carrier grade open environment	Y.2900–Y.2999
FUTURE NETWORKS	Y.3000–Y.3499
CLOUD COMPUTING	Y.3500–Y.3599
BIG DATA	Y.3600–Y.3799
QUANTUM KEY DISTRIBUTION NETWORKS	Y.3800–Y.3999
INTERNET OF THINGS AND SMART CITIES AND COMMUNITIES	
General	Y.4000–Y.4049
Definitions and terminologies	Y.4050–Y.4099
Requirements and use cases	Y.4100–Y.4249
Infrastructure, connectivity and networks	Y.4250–Y.4399
Frameworks, architectures and protocols	**Y.4400–Y.4549**
Services, applications, computation and data processing	Y.4550–Y.4699
Management, control and performance	Y.4700–Y.4799
Identification and security	Y.4800–Y.4899
Evaluation and assessment	Y.4900–Y.4999

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

Recommendation ITU-T Y.4419

Requirements and capability framework of smart utility metering (SUM)

Summary

Recommendation ITU-Y.4419 specifies requirements and capabilities for support for smart utility metering (SUM).

Smart utility metering (SUM) can provide remote data collection for utility metering and device maintenance in real time and can support a variety of applications. Compared with other types of utility metering, SUM intends to improve utility management and meet the emerging requirements from advanced applications, such as intelligent utility scheduling.

History

Edition	Recommendation	Approval	Study Group	Unique ID*
1.0	ITU-T Y.4419	2021-07-14	20	11.1002/1000/14736

Keywords

Capabilities, IoT, requirements, smart utility metering.

* To access the Recommendation, type the URL http://handle.itu.int/ in the address field of your web browser, followed by the Recommendation's unique ID. For example, http://handle.itu.int/11.1002/1000/11830-en.

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Table of Contents

Recommendation ITU-T Y.4419

Requirements and capability framework of smart utility metering (SUM)

1 Scope

This Recommendation specifies the requirements and capability framework of smart utility metering (SUM).

As a smart application of the internet of things (IoT) in the field of utility metering, SUM is an important means to improve utility metering management.

The scope of this Recommendation includes:

– Introduction of SUM;

– Requirements of SUM;

– Capability framework of SUM.

Use cases of SUM are provided in Appendix I.

NOTE 1 – Though different utilities, such as electricity, water and gas, are considered in this context, the scope of this Recommendation focuses on the common requirements and capability framework for SUM. The specific requirements and capability framework for each utility, including utility management and utility delivery, lie outside the scope of this Recommendation.

NOTE 2 – Metering related security aspects are specified in [b-ITU-T X.1332] and are not addressed in this Recommendation.

NOTE 3 – Policy and regulation matters lie outside the scope of this Recommendation.

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 Y.4000] Recommendation ITU-T Y.4000/Y.2060 (2012), *Overview of the Internet of things.*

[ITU-T Y.4100] Recommendation ITU-T Y.4100/Y.2066 (2014), *Common requirements of the Internet of things.*

3 Definitions

3.1 Terms defined elsewhere

This Recommendation uses the following terms defined elsewhere:

3.1.1 device [ITU-T Y.4000]: With regard to the Internet of things, this is a piece of equipment with the mandatory capabilities of communication and the optional capabilities of sensing, actuation, data capture, data storage and data processing.

3.1.2 Internet of things (IoT) [ITU-T Y.4000]: A global infrastructure for the information society, enabling advanced services by interconnecting (physical and virtual) things based on existing and evolving interoperable information and communication technologies.

NOTE 1 – Through the exploitation of identification, data capture, processing and communication capabilities, the IoT makes full use of things to offer services to all kinds of applications, whilst ensuring that security and privacy requirements are fulfilled.

NOTE 2 – From a broader perspective, the IoT can be perceived as a vision with technological and societal implications.

3.1.3 meter [b-ITU-T Y.4109]: A device that measures and optionally records the quantity, degree or rate of something, especially the amount of electricity, gas or water used.

NOTE – A meter is responsible for measuring the total amount of something consumed in a period.

3.1.4 usage metering [b-ITU-T X.742]: The abstraction of activities that monitor the utilization of resources, for the purpose of accounting and controlling the recording of usage data.

3.2 Terms defined in this Recommendation

This Recommendation defines the following term:

3.2.1 utility: A service that is used by the public, such as an electricity, water or gas supply.

4 Abbreviations and acronyms

This Recommendation uses the following abbreviations and acronyms:

API Application Programming Interface

GNSS Global Navigation Satellite System

IoT Internet of Things

SUM Smart Utility Metering

Wi-Fi Wireless Fidelity

5 Conventions

In this Recommendation:

The phrase "is required to" indicates a requirement that must be strictly followed and from which no deviation is permitted if conformance to this document is to be claimed.

The phrase "is recommended" indicates a requirement that is recommended but which is not absolutely required. Thus, this requirement needs not be present to claim conformance.

The phrase "can optionally" and "may" indicate an optional requirement that is permissible, without implying any sense of being recommended. These terms are not intended to imply that the vendor's implementation must provide the option and the feature can be optionally enabled by the network operator or service provider. Rather, it means the vendor may optionally provide the feature and still claim conformance with the specification.

6 Introduction to smart utility metering

Utility metering is widely used in private homes and commercial areas, providing measurements of utility services including electricity, gas and water. Utility metering applications include data management and device maintenance.

SUM provides self-monitoring utility metering that supports data management with remote data collection and efficient device maintenance, and can also support other applications. Remote data

collection saves human resources and improves data management efficiency. Efficient device maintenance leads to reduced system downtime and operation interruptions. Advanced applications, such as utility quality monitoring, can improve the user experience.

This Recommendation describes requirements and a capability framework for SUM.

Figure 1 is an overall conceptual diagram of SUM.

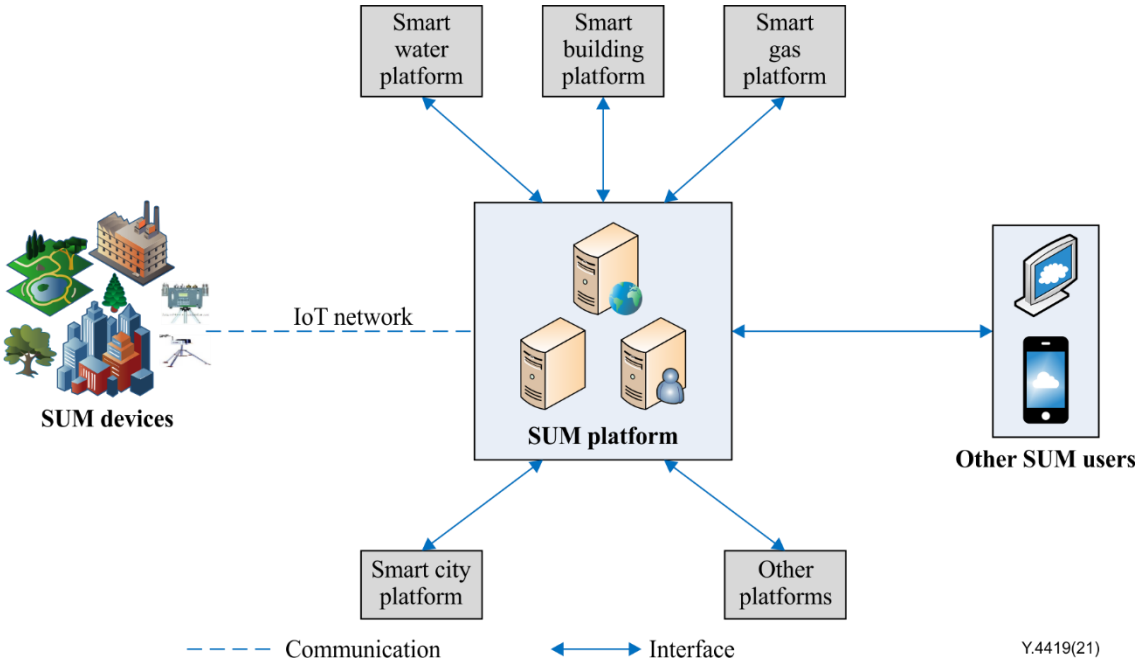

Figure 1 – Overall conceptual diagram for SUM

SUM devices measure utility information, which includes but is not limited to utility consumption. SUM devices consist of meters connected to an IoT network. The IoT network enables the interaction between SUM devices and the SUM platform. The SUM platform is responsible for collecting and managing metering data. It provides the resulting metering information to SUM users, including utility consumers and providers, third party applications and other platforms.

NOTE – The SUM platform may interact with other platforms for mutual exchange of beneficial information as shown in Figure 1. In some scenarios, the SUM platform may even be integrated within a larger scope system such as a smart city system.

7 Requirements of SUM

SUM devices are resource-constrained and time delay insensitive, and have low power consumption. Based on these characteristics, SUM has some specific requirements.

In addition to the common requirements specified in [ITU-T Y.4100], specific requirements for SUM are listed in clauses 7.1 and 7.2.

7.1 SUM platform requirements

The SUM platform is required:

– To collect measurement information;

NOTE 1 – Measurement information includes utility consumption, other data from other sensors (e.g., water pressure), and device information (e.g., working status, working battery capacity).

– To check and analyse the integrity and correctness of the collected data;

NOTE 2 – When received, the SUM platform discards incomplete or erroneous data. Re-transmission of such data is not required, in order to save power consumption.

– To process and analyse collected data, in order to implement applications such as metering data analysis and faulty SUM device detection;
– To provide capabilities of data presentation to SUM users;

NOTE 3 – Examples of data presentation modalities include web portal and mobile applications.

– To manage the location information of SUM devices as appropriate;
– To provide detection of faulty SUM devices;
– To report faulty SUM devices and present fault information;
– To support remote SUM device configuration;

NOTE 4 – For example, the platform can set the uploading time of metering information for SUM devices.

– To support data recovery after platform failures.

The SUM platform can optionally:

– Expose open application programming interfaces (APIs) to third party applications for SUM service purposes;
– Provide interfaces to other platforms to exchange information as appropriate;
– Manage SUM device maintenance records and send reminders to relevant personnel when any scheduled maintenance procedure is needed.

NOTE 5 – For example, the platform can manage replacement and calibration records.

7.2 SUM device requirements

SUM devices are required:

– To collect measurement information;
– To transfer collected measurements in an appropriate format;

NOTE 1 – The reporting interval is normally set to 1 day or 1 week. It can be modified by SUM device configuration.

NOTE 2 – To avoid too many wake-ups and interactions, the reported data is suggested to be aggregated in one message, so the SUM device can transfer only once to complete the reporting.

– To store and execute configuration settings received from the SUM platform;
– To report fault information to the SUM platform where possible.

SUM devices are recommended:

– To be time synchronized with the SUM platform.

NOTE 3 – Time synchronization does not imply a frequent and/or constant exchange with the platform (in line with the SUM devices' limited resources).

SUM devices can optionally:

– Report their location information to the SUM platform where possible.

NOTE 4 – SUM devices may not have location capabilities such as global navigation satellite system (GNSS) and wireless fidelity (Wi-Fi) [b-IEEE-802.11] positioning.

8 Capability framework of SUM

Based on the IoT reference model specified in [ITU-T Y.4000], Figure 2 illustrates the SUM capability framework, which consists of four layers and two cross-layer capability groups.

In addition to the capabilities specified in [ITU T Y.4000], specific capabilities are required for the SUM platform and SUM devices. These specific capabilities are shown via the yellow highlighted boxes and their explanatory panels in Figure 2.

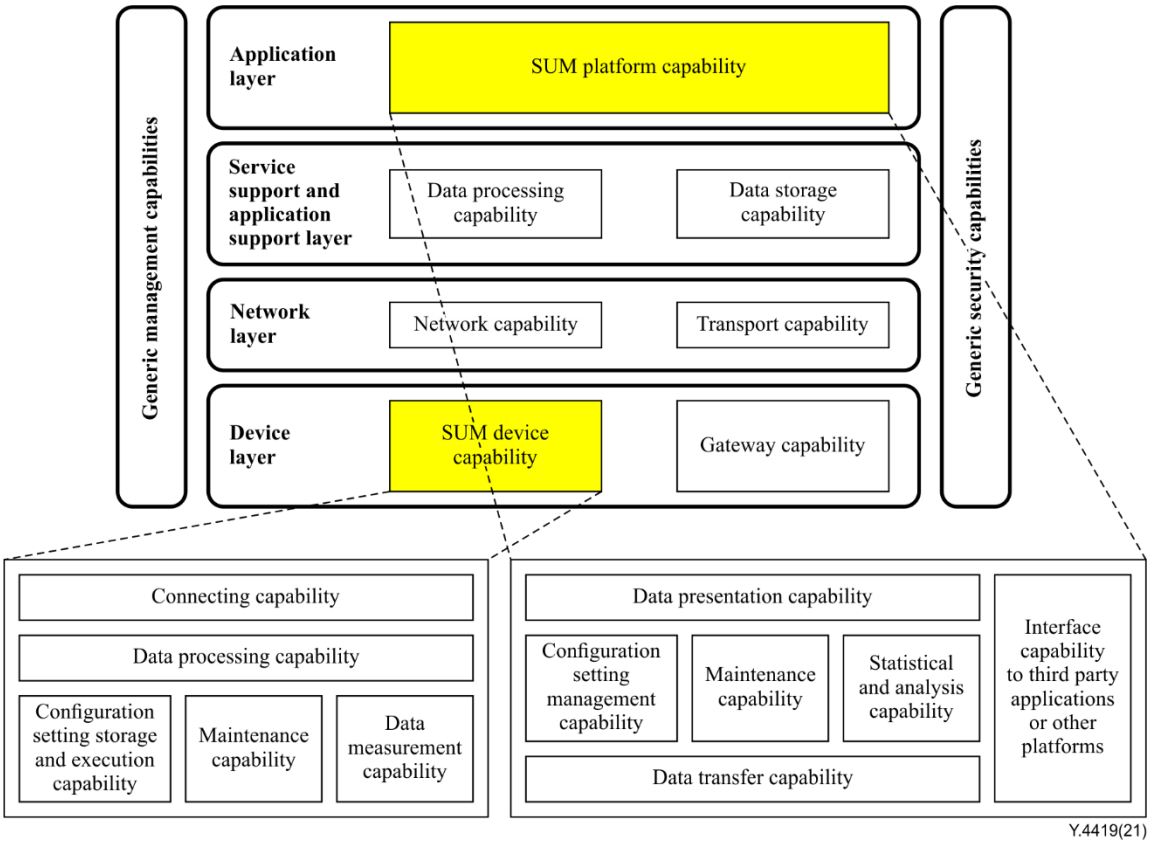

Figure 2 – Capability framework for SUM

8.1 Smart utility metering platform capabilities

According to the SUM requirements specified in clauses 7.1 and 7.2, the SUM platform capabilities include those for data transfer, configuration setting management, maintenance, statistics and analysis, data presentation and interface to other platforms. The details of these capabilities are described in clauses 8.1.1 to 8.1.6.

NOTE – Additional SUM platform capabilities related to object modelling techniques, for example [b-IEC TS 62056-6-9], are not addressed in this Recommendation.

8.1.1 Data transfer capability

The data transfer capability transfers data between different capabilities of the SUM platform. It includes but is not limited to:

– Sending the measurement, identity and type of SUM devices to maintenance management capability, and statistics and analysis capability;

– Sending configuration settings from the configuration setting management capability to SUM devices;

– Checking and analysing the integrity and correctness of the collected SUM data, discarding it when it is erroneous or incomplete.

8.1.2 Configuration setting management capability

The configuration setting management capability manages the creation, modification and deletion of configuration settings. It includes but is not limited to:

– Creating configuration settings, such as the measurement frequency and time interval of report;

– Modifying and deleting configuration settings;

– Sending configuration settings to the data transfer capability;

– Caching commands when SUM devices are offline, and sending commands when SUM devices are online.

8.1.3 Maintenance capability

The maintenance capability maintains SUM devices. It includes but is not limited to:

– Storing, updating and deleting SUM device information, such as identity, type and location information;

– Addressing queries about device information and operating status to SUM devices;

– Recognizing and detecting the identity, type and operating status of SUM devices from the data transfer capability;

– Informing maintenance personnel when a fault is detected;

– Automatically generating fault reports from the operating status;

– Optionally managing the SUM device maintenance records and sending reminders to relevant personnel when any scheduled maintenance procedure is needed;

– Providing data recovery after platform failures.

8.1.4 Statistics and analysis capability

The statistics and analysis capability analyses measurement data, and generates analysis reports and warning events. It includes but is not limited to:

– Processing measurement data based within one area or one time period, such as water consumption in a certain area or electricity consumption within a certain time interval;

– Detecting abnormal measurement data, and generating warning events.

8.1.5 Data presentation capability

The data presentation capability presents measurement information. It includes, but is not limited to, interface provision:

– To authorized SUM users to present raw measurement data and analysis reports;

– To authorized SUM users to present the physical distribution of all SUM devices, and the maintenance status of each SUM device;

– To authorized SUM users to present the physical distribution of faulty SUM devices with their fault information;

– To authorized SUM users to present abnormal data and warnings about particular SUM devices.

8.1.6 Interface capability to third party applications or other platforms

The interface capability to third party applications or other platforms provides interfaces between the SUM platform and third party applications or other platforms. It includes but is not limited to:

– The optional exposure of open APIs to third party applications for SUM service purposes;

– The optional provision of interfaces to other platforms to exchange information as appropriate.

8.2 Smart utility metering device capabilities

According to the SUM requirements specified in clause 7.2, the SUM device capabilities include those for data measurement, data processing, connecting, configuration setting storage and execution, and maintenance.

8.2.1 Data measurement capability

The data measurement capability measures SUM data. It includes but is not limited to:

– Measuring SUM information related to utility consumption, such as electricity consumption;

– Measuring SUM information related to utility quality and status, such as water pressure and remaining battery power.

8.2.2 Data processing capability

The data processing capability processes data. It includes but is not limited to:

– Formatting data as appropriate for communication purposes.

8.2.3 Connecting capability

The data connecting capability enables SUM devices to communicate with the SUM platform. It includes but is not limited to:

– Setting up communication between SUM devices and the SUM platform;

– Receiving configuration settings from the SUM platform;

– Sending configuration settings to configuration setting storage and execution capability;

– Periodically reporting working status from maintenance capability to the SUM platform;

– Reporting fault information from maintenance capability to the SUM platform;

– Regularly reporting measurement data from the data measurement capability to the SUM platform.

8.2.4 Configuration setting storage and execution capability

The configuration setting storage and execution capability manages configuration settings. It includes but is not limited to:

– Receiving and storing configuration settings from the connecting capability;

– Automatically executing the configuration settings when new configuration settings are received.

8.2.5 Maintenance capability

The maintenance capability maintains SUM devices. It includes but is not limited to:

– Monitoring the working status of SUM devices;

– Detecting abnormal measurements and reporting the fault information automatically to the connecting capability.

Appendix I

Use cases of smart utility metering

(This appendix does not form an integral part of this Recommendation.)

This appendix provides some use cases of SUM.

Figure I.1 shows smart water metering as a typical application of SUM. Through the IoT network and SUM platform, smart water metering can provide remote data collection, efficient device maintenance, and flexible data analysis and presentation.

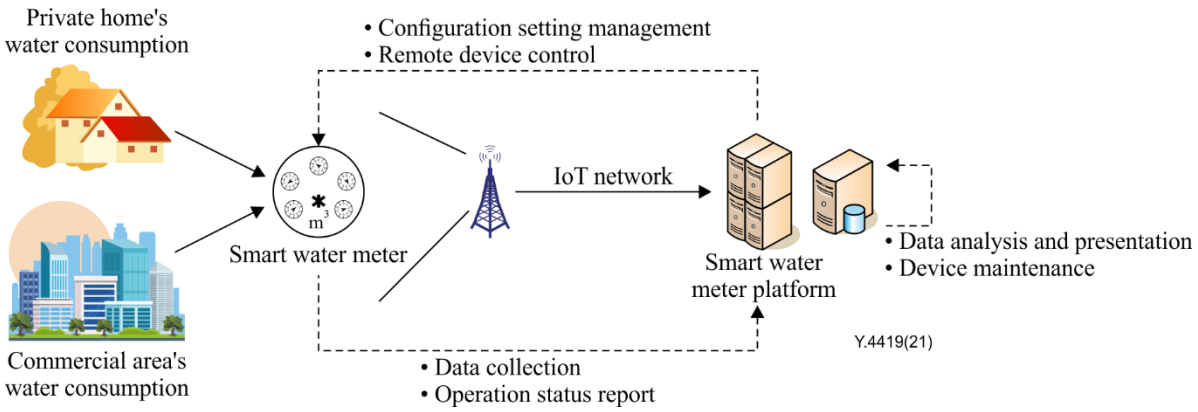

Figure I.1 – Smart water metering

I.1 Remote data collection

A smart water meter sends water consumption data to the SUM platform periodically through the IoT network. This time period can be modified in the configuration setting.

The SUM platform can also collect other data from the smart water meter through sensors such as water pressure sensors. Water pressure is used to analyse the status of the water pipes and water storage.

I.2 Device maintenance

The SUM platform can manage various aspects of smart water meters, such as device information management, device operation status analysis, configuration setting and remote device control.

I.2.1 Device information management

When a smart water meter is installed and powered up, it is registered on the SUM platform with its device information, such as its identity and device type. Maintenance personnel can also add the device location to the device information. Device information can be modified, queried and deleted on the SUM platform.

I.2.2 Device operation status analysis

The smart water meter reports its operation status periodically to the SUM platform. The SUM platform analyses whether the smart water meter is working well. When a faulty device is detected, the SUM platform informs the maintenance personnel promptly.

I.2.3 Configuration setting

The SUM platform can remotely update the smart water meter configuration to set device working parameters for a single device or a group of devices on demand.

I.2.4 Remote device control

Maintenance personnel can turn off a specific smart water meter to cut off the water supply if its user is in arrears. Maintenance personnel can also turn off a group of devices when a water pipe is broken. In addition, the SUM platform can query smart water meters so that they can react back immediately with water consumption data, and accurate consumption invoices can then be issued.

I.3 Data analysis and presentation

The SUM platform can analyse water consumption in a certain area or within a certain time interval.

The SUM platform can present raw measurement data, analysis reports, physical distribution and maintenance status of a single smart water meter. The platform can also present faulty device information and abnormal data to the user.

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