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colour inside

Internet of things (IoT) – Application of sensor network for wireless gas meters

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FOREWORD

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ISO/IEC TR 30148, which is a Technical Report, has been prepared by subcommittee SC 41: Internet of Things and related technologies, of ISO/IEC joint technical committee 1: Information technology.

The text of this Technical Report is based on the following documents:

Draft TR	Report on voting
JTC1-SC41/90/DTR	JTC1-SC41/104/RVDTR

Full information on the voting for the approval of this Technical Report can be found in the report on voting indicated in the above table.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

A bilingual version of this publication may be issued at a later date.

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INTRODUCTION

With the improvement of wireless communication technologies and the demand for intelligent products required by home automation, factory automation and so on, wireless gas meter systems can develop in terms of safety, reliability, and convenience. Wireless gas meters can not only avoid the errors from manual meter reading and issues such as unstable signals during traditional gas meter reading, but also achieve functions such as dynamic rates, energy management, event alarm service, real-time data collection and analysis.

From the perspective of gas meter companies, the promotion of wireless gas meters is conducive to reducing labour costs and improving efficiency. From the point of view of gas meter manufacturers, the implementation of wireless gas meters will also help them to reduce costs. Consumers will readily accept the lower cost and increased convenience of wireless gas meters. So in the near future, with significant cost benefits and technical advantages, wireless gas meters will become more important in the market.

INTERNET OF THINGS (IoT) – APPLICATION OF SENSOR NETWORK FOR WIRELESS GAS METERS

1 Scope

This document describes

– the structure of wireless gas meter networks, and
– the application protocol of wireless gas meter networks.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at http://www.electropedia.org/
- ISO Online browsing platform: available at http//www.iso.org./obp

3.1
access point
equipment that is used to connect each wireless gas meter to other networks

3.2
acquisitor
equipment that is used for data acquisition, data transmission, and data relay for wireless gas meters

3.3
application layer
layer that performs calculation, processing and management of data collected by the sensing layer

3.4
application sub-layer
layer that provides services for the application layer

3.5
entity
unit that connects to other units defined in the wireless gas meter networks reference architecture with a distinct set of attributes

3.6
gateway
device that is used to connect wireless gas meter networks to outside IP networks

3.7
handheld device
portable device that is used for provisioning firmware updates and monitoring device status

3.8
message
data unit conveyed between client and server that represents a specific service request or response

3.9
user application object
information processing element for a specific process

3.10
user application process
active process that is used to implement data collection and processing at the upper layer of the application layer

3.11
wireless gas meter
instrument for recording the quantity of gas passing through a particular outlet, which exchanges data with external devices with a microprocessor and a wireless communication chip as its core

3.12
wireless gas meter system
system that is composed of remote meter reading management, payment management, accounting management, gas management and data management

4 Symbols and abbreviated terms

AL	application layer
APDU	application layer protocol data unit
ASL	application sub-layer
ASLDE	application sub-layer data entity
ASLME	application sub-layer management entity
DMAP	device management application process.
GPRS	general packet radio services
ID	identifier
MIB	management information base
PDU	protocol data unit
R/R	request/response
P/S	publisher/subscriber
R/S	report source/sink
SAP	service access point
UAP	user application process
UAO	user application object
VCR	virtual communication relationship
VCR_ID	virtual communication relationship identifier

5 Network structure

The overall structure of the wireless gas meter networks can be divided into three levels: the underlying wireless gas meter networks, the internet/mobile networks, the data centre/application server/cloud management platform. The gateway obtains data information such as balance, valve opening and closing, and device health status, and sends to the data centre. The cloud management platform can control and manage at any time, and users query information through the application server. They are shown in Figure 1.

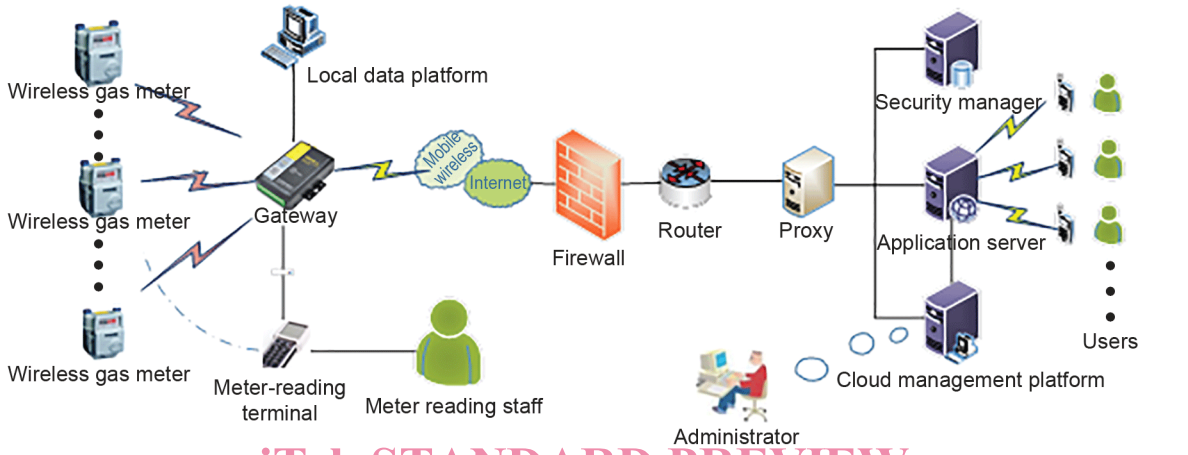

Figure 1 – The structure of the wireless gas networks

The components of the wireless gas meter networks are as follows.

a) Security manager

Application software that supervises various operational security aspects of a multi-device network (e.g. certification function), usually through interaction with wireless gas meter in the supervised device(s). See Annex A.

b) Application server

It is installed in the gas supplier or gas management centre. It is a platform for accessing the Internet and managing user applications. Users can perform business management operations such as gas meter recharging, gas meter status monitoring and gas data storage through the application.

c) Cloud management platform

It is installed in the gas supplier or gas management centre. It is a platform for controlling and managing wireless gas meters. It has functions such as equipment management, network management, network security management and time synchronization.

d) Gateway

It is installed at a place without potential explosion risks and far away from where gas is used. It is important for a gateway to be a safe distance from wireless gas meters. It can cover all gas meters to manage network nodes remotely. It can receive management and control messages from the remote management platform. The main functions are as follows: transmission and storage of wireless gas meter status information; conversion of wireless protocol to wired protocol; management of wireless gas meter; information security management for gas meter identification.

e) Wireless gas meter

Instrument intended to measure, memorize and display the quantity of gas passing the flow sensor. It is installed in locations where there are potential explosion risks and meets the explosion-proof performance functions. If it is exposed to weather it should also be weather-proof against dust and water entry and the effect of UV sunlight exposure and ambient temperature ranges expected at the installed location, if these would impair its function and safety. Wireless connections may include short distance wireless, GPRS, long range wireless and narrowband IoT.

6 Application layer protocol

6.1 Overview

6.1.1 General

AL describes the interaction processes and services between wireless gas meter and wireless gas meter system.

This AL for wireless gas meter networks includes:

– structure and functions;
– three communication models;
– application services and corresponding service primitives;
– message format.

6.1.2 AL function

The AL describes UAP, ASL and DMAP. The DMAP is a special type of UAP, which is dedicated to managing the device and its communications services. DMAP can realize system management functions. AL defines application objects to interact with the wireless gas meter system. It can also define communication services to support interaction between gas meter application processes and ASL.

6.1.3 AL structure

Application layer structure is shown in Figure 2.

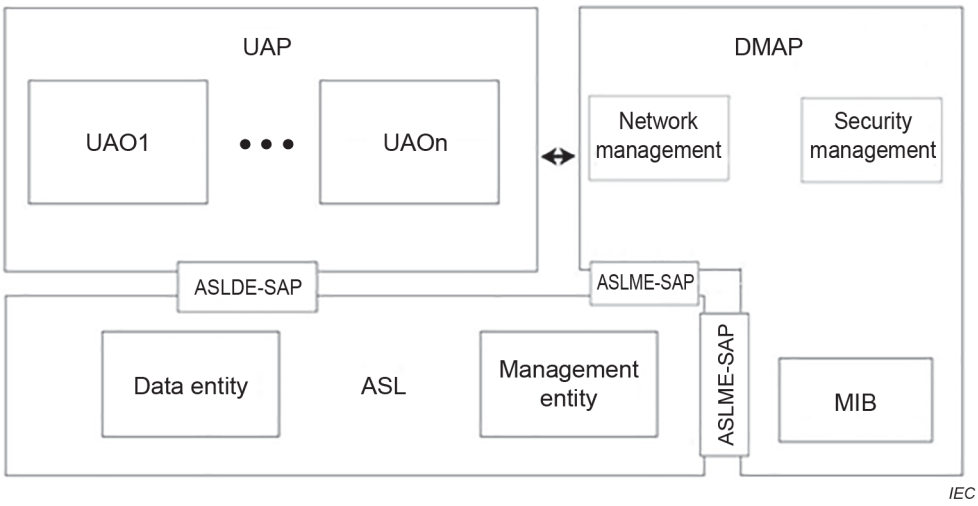

Figure 2 – AL structure

UAP collects data from the wireless gas meter and processes the data; UAP consists of one or more UAOs. DMAP includes the network management module, the security management module and the MIB module. The network management is responsible for managing the attributes of network equipment which is related to communication and networking processes. The security management manages the attributes associated with network security. The information in the MIB exists in the form of attributes to monitor and configure wireless network parameters for gas meters. ASL includes data entities and management entities. Data entities provide data communication services, send data to the network layer and receive data from it. The management entity implements the data interaction with the MIB. UAP and DMAP interact with AL.

ASLDE–SAP and ASLME–SAP are interfaces for communication among parts. ASL provides transparent data transmission services between ASL and UAP.

6.2 User application process

6.2.1 General

According to the ISO/OSI reference model defined, the UAP is performed for specific applications in the network and an integral part of distributed applications in wireless gas meter networks.

6.2.2 Functions of UAP

The functions of the user application process mainly include the following.

– It can collect gas consumption, balance and remaining power in home and industrial sites through a wireless gas meter. After processing this information, it is transmitted to the computer control centre through the data channel.

– It can generate and issue an alarm, and the UAO itself will send an alarm signal when an operating condition is abnormal. This alarm information includes data anomalies, low power and damage caused by external factors, etc.

6.2.3 User application object

A user process consists of one or more user application objects. Each user application object can be defined according to different functions. The user application object is defined as the data acquisition, processing and distribution.

Each user application object is addressed based on the object ID. This parameter uses index addressing when its internal parameters are operated remotely.

6.3 Device management application process

Each device contains a DMAP. The DMAP includes a security device management function. The DMAP cooperates with system manager and the security manager to enable the use of system resources by the wireless gas meter and the wireless gas meter system. For example, the DMAP may ask to join the network, ask for communication bandwidth, request a communication configuration, and report its health. The system manager and the security manager of the wireless gas meter authorize the wireless gas meter to join the network, allocate communication bandwidth, configure the wireless gas meter, and collect health reports. These health reports are stored in the wireless gas meter system manager and are used to make communication configuration decisions.