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Information technology — Sensor networks: Sensor Network Reference Architecture (SNRA) —

Part 7: Interoperability guidelines

Technologies de l'information — Réseaux de capteurs: Architecture de référence pour réseaux de capteurs —
Partie 7: Lignes directrices pour l'interopérabilité

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Foreword

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International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of the joint technical committee is to prepare International Standards. Draft International Standards adopted by the joint technical committee are circulated to national bodies for voting. Publication as an International Standard requires approval by at least 75 % of the national bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO and IEC shall not be held responsible for identifying any or all such patent rights.

ISO/IEC 29182-7 was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology.*

ISO/IEC 29182 consists of the following parts, under the general title *Information technology — Sensor networks: Sensor Network Reference Architecture (SNRA)*:

— *Part 1: General overview and requirements*

— *Part 2: Vocabulary and terminology*

— *Part 3: Reference architecture views*

— *Part 4: Entity models*

— *Part 5: Interface definitions*

— *Part 6: Applications*

— *Part 7: Interoperability guidelines*

Introduction

A wide range of applications has been proposed for sensor networks. In practice, however, sensor networks have been built and deployed for a relatively small number of applications. This is partly due to the lack of a business case for certain applications and partly due to technical challenges in building a non-trivial sensor network of reasonable complexity. The main reason for this impediment is multi-disciplinary expertise — such as sensors, communications and networking, signal processing, electronics, computing, and cyber security is required to design a sensor network. Presently, the design process is so complex that one can leverage little from one sensor network design to another. It appears as if one has to start from almost scratch every time one wishes to design and deploy a sensor network. Yet, upon closer inspection, there are many commonalities in instantiations of sensor networks that realize various applications. These commonalities include similarities in the choice of network architecture and the entities/functional blocks that are used in the architecture.

The purpose of the ISO/IEC 29182 series is to

— provide guidance to facilitate the design and development of sensor networks,

— improve interoperability of sensor networks, and

— make sensor networks plug-and-play, so that it becomes fairly easy to add/remove sensor nodes to/from an existing sensor network.

The ISO/IEC 29182 series can be used by sensor network designers, software developers, and service providers to meet customer requirements, including any applicable interoperability requirements.

The ISO/IEC 29182 series is comprised of seven parts. Brief descriptions of these parts are given next.

ISO/IEC 29182-1 provides a general overview and the requirements for the sensor network reference architecture.

ISO/IEC 29182-2 provides definitions for the terminology and vocabulary used in the reference architecture.

ISO/IEC 29182-3 presents the reference architecture from various viewpoints, such as business, operational, system, technical, functional, and logical views.

ISO/IEC 29182-4 categorizes the entities comprising the reference architecture into two classes of physical and functional entities and presents models for the entities.

ISO/IEC 29182-5:2013 provides detailed information on the interfaces among various entities in the reference architecture.

ISO/IEC 29182-6 provides detailed information on the development of International Standardized Profiles.

ISO/IEC 29182-7 provides design principles for the reference architecture that take the interoperability requirements into account.

There are no requirements for compliance in ISO/IEC 29182-1 to ISO/IEC 29182-7. Users are to ensure that the sensor nodes and the related sensor network are compliant with the application or deployment governing body.

Information technology — Sensor networks: Sensor Network Reference Architecture (SNRA) —

Part 7: Interoperability guidelines

1 Scope

This part of ISO/IEC 29182 provides a general overview and guidelines for achieving interoperability between sensor network services and related entities in a heterogeneous sensor network.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO/IEC 29182-1, *Information technology — Sensor networks: Sensor Network Reference Architecture (SNRA) — Part 1: General overview and requirements*

ISO/IEC 29182-2, *Information technology — Sensor networks: Sensor Network Reference Architecture (SNRA) — Part 2: Vocabulary and terminology*

ISO/IEC 29182-5:2013, *Information technology — Sensor networks: Sensor Network Reference Architecture (SNRA) — Part 5: Interface definitions*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO/IEC 29182-2 apply.

4 Symbols (and abbreviated terms)

This part of ISO/IEC 29182 uses the following abbreviations and acronyms.

ADSL	Asymmetric Digital Subscriber Line
API	Application Programming Interface
GSM	Global System for Mobile Communication
ICT	Information and Communication Technologies
SNRA	Sensor Network Reference Architecture
TCP/IP	Transfer Control Protocol/Internet Protocol
UWB	Ultra Wideband
WCDMA	Wideband Code Division Multiple Access

5 Overview of interoperability between heterogeneous sensor networks

5.1 General

A sensor network is a system of spatially distributed sensor nodes interacting with each other and, depending on applications, with ICT infrastructures, in order to acquire, process, and provide information about the physical world and optionally react to such information [ISO/IEC 29182-1].

There are many different sensor network applications in a variety of domains such as environment monitoring, logistics management, industrial automation, intelligent highway system, and perimeter protection. From one sensor network service domain to another, significant differences exist in service requirements, service types, processing functions, interfaces, operational attributes, data formats, and so on. These differences influence the interoperability of sensor networks.

Due to these differences, a sensor network may be classified into two different types of sensor network, a homogeneous sensor network and a heterogeneous sensor network.

The differentiation of the homogeneous and heterogeneous sensor networks can be viewed from sensor type perspective and from communication protocol perspective. From the sensor type perspective, the homogeneous sensor networks can be classified as having the same type or functionally identical sensor nodes while the heterogeneous sensor networks can be classified as having different types or functionally different sensor nodes. From the communication protocol perspective, the homogeneous sensor networks can be classified as having the same or interoperable protocols while the heterogeneous sensor networks can be classified as having different or not interoperable types of protocols. In this standard, the communication protocol perspective is used to differentiate the types of sensor networks.

The typical difference is the communication protocol. There are various communication protocols for sensor networks, such as IEEE 802.15.4x series, IETF 6LoWPAN, ZigBee, Bluetooth, and UWB.

From the communication protocol perspective, homogeneous sensor networks are by definition interoperable with each other, because they use the same communication protocol between entities of their service domains. On the other hand, heterogeneous sensor networks are not able to interwork with each other due to the differentiation of the communication protocols they use.

Heterogeneity is a common feature of sensor networks, but it may cause various problems. A sensor network application may rely on different sub-networks of a heterogeneous sensor network.

Therefore, the interoperability between heterogeneous sensor networks is a great challenge in the Sensor Network Reference Architecture (SNRA).

5.2 Interoperability in sensor network service framework

From a service-oriented viewpoint, the flow of information from sensor nodes to service providers for providing specific sensor network services to users, the overall architecture of sensor network can be represented in the hierarchical architecture.

This hierarchical architecture, which is called the sensor network service framework, is illustrated in Figure 1. It is the same as Figure 7 in ISO/IEC 29182-5. It has been reproduced in this document for ease of reference.

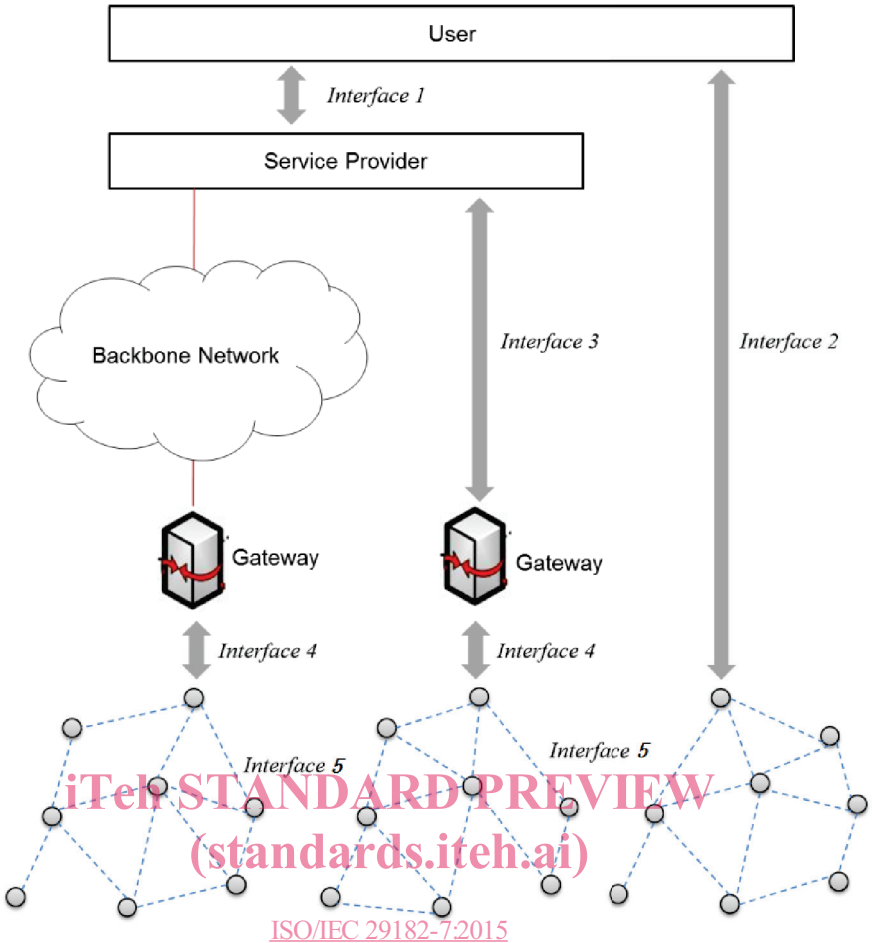

Figure 1 — Interfaces and entities of the sensor network service framework

There are various communication protocols or interfaces for each entity in Figure 1. Interoperability implies an internetworking capability between the entities in the sensor network service framework. Figure 2 is a graphical representation of an interoperable sensor network service framework with the arrows representing the interfaces that enable seamless interoperability between the entities.

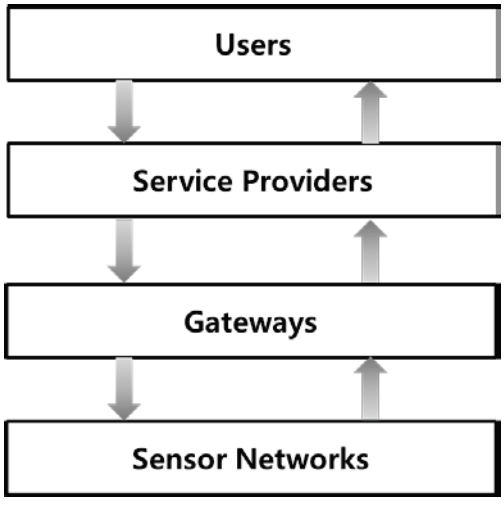

Figure 2 — Graphical representation of an interoperable sensor network service framework

Interoperability also needs to exist vertically so that information may be exchanged seamlessly within the hierarchical structure of the sensor networks supporting a complex system of systems. Therefore,