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Title: **ISO/IEC WD 29182, Reference architecture for sensor network applications and services (June 2009)**

Status:

This an output text of ISO/IEC WD 29182, developed in SC 6/WG 7 meeting in June 2009. This is a first working draft text and it is decided to circulate to SC 6 National Bodies for review and comments to the next SC 6/WG 7 meeting in January 2009.

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

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

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member 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 shall not be held responsible for identifying any or all such patent rights.

Technical Committee ISO/IEC JTC 1, Information technology, Subcommittee SC 6, *Telecommunications and information exchange between systems,* Working group 7, *Network and transport layers,* prepared ISO/IEC 29182

Introduction

To be added

Information technology — Telecommunications and information exchange between systems — Reference architecture for sensor network applications and services

1 Scope

This International Standard specifies the reference architecture for sensor network applications and service and covers the following:

- Requirements analysis of sensor network applications and services
- Identification of the network functionalities required by different sensor network applications
- Reference architecture for sensor networks functionalities supporting various sensor network applications and services
- Specification of interfaces for sensor network functionalities supporting sensor networks

2 Normative references

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

To be added

3 Terms and definitions

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

[Editor's Note] The following terms and definitions refers to ISO/IEC JTC1 SGSN TD049 and ITU-T Y.101 "Global Information Infrastructure terminology: Terms and definitions" and ITU-T JCA-NID "Draft for the terms and definitions relevant to the USN scope of ITU-T JCA-NID".

3.1

actuator
A device that performs a physical response caused by an input signal.

3.2

sensor
A device that observes phenomenon/phenomena, measures physical property and quantity of the observation, and converts the measurement into a signal.

Note:

- Signal can be electrical, chemical, or other types of sensor responses.
- Signal can be represented by 1-D, 2-D, 3-D, or higher dimensional data.

3.3

sensor node
A device that consists of at least one sensor and zero or more actuators, and processing and networking capabilities using wired or wireless means.

3.4

sensor network
A system of spatially distributed sensor nodes interacting with each other and, depending on applications, interacting with other infrastructure in order to acquire, process, transfer, and provide information extracted from the physical world.

3.5

sensor network applications
A structured set of capabilities, which provide value-added functionality supported by one or more services such as, home utility monitoring and control, industrial automation, infrastructure and environment monitoring, weather and disaster condition monitoring and emergency alert.

[Editor's Note] The definition of Sensor Network Applications refers to ISO/IEC JTC1 SGSN TD049 and ITU-T Y.101 "Global Information Infrastructure terminology: Terms and definitions".

3.5

sensor network device
The sensor network device is sensor node or sensor network gateway.

3.6

sensor network gateway
The sensor network gateway represents the bridge between the sensor network itself and the backend system. Therefore, it has to provide wired/wireless interface(s) to other sensor nodes as well as a wired (e.g., Ethernet) or wireless (e.g., mobile Ethernet via WLAN, UMTS or SatCom) interface to existing IT infrastructures.

3.7

sensor network services
A structure set of capabilities offered by the sensor nodes or sensor networks to support sensor network applications.

[Editor's Note] The definition of Sensor Network Services refers to ISO/IEC JTC1 SGSN TD049 and ITU-T Y.101 "Global Information Infrastructure terminology: Terms and definitions".

4 Requirements of sensor network applications and services

Sensor network applications and services have specific characteristics with different service requirements and functional requirements from each other. However characteristics of sensor network applications and services can be distinguished into basic service model and advanced service model from the way of application model, operation process, operation domain and type of user.

4.1 Classification of service model

4.1.1 Basic service model

A basic service model has following characteristics:

Table 1 — Features of basic service model

Features	Type	Description
Application model	Pre-defined	Sensor networks are installed for specific and static purposes such as structures monitoring, street light control, agriculture monitoring and management, surveillance, facilities management, etc.
Operation process	Straightforward	Straight forward process progresses into sensing, transmitting, processing and provisioning. Sensor nodes and resulting sensor networks detect physical status; they transmit sensor data to backend application systems; the application systems collect sensor data and perform data processing functions; and the application systems produce value-added information contents and services.
Operation domain	Single	Sensor data are captured, transmitted, processed and delivered within a single operation domain.
Type of user	Dedicated	Value-added data are provided to dedicated users: owner and partners.

4.1.2 Advanced service model

An advances service model can be considered as a service infrastructure and has following characteristics:

Table 2 — Features of advanced service model

Features	Type	Description

Application model	Dynamic	Services depend on the usage of users who anybody can be. It is very difficult to fix application features and relevant functions statically in advance. For weather information services as an example: – Fishermen may request on-demand and periodic weather information for fishing; – Tourists may request periodic and alarming information of the nature condition for a week, a few days, or a month by a service subscription; – National disaster center may request the whole weather information to observe the natural phenomena of an area and detect emergency situations; etc.
Operation process	Elaborated	Transmitting, processing and provisioning step have additional functions as follows: – Various sensor networks may be integrated and sensor data may be acquired via other sensor networks by business contracts; – Due to dynamic service models, a variety of application functions have to be involved such as filtering, analyzing, context processing, data mining, decision making, forecasting, integration, exporting, etc.; and – Since anybody can be information user and information contents cannot be pre-defined, sensor data may be delivered in different forms such as text, audio, voice, image, etc. according to information users.
Operation domain	Multiple	Multiple business domains are incorporated by business partnerships.
Type of user	Dedicated and arbitrary	Services are provided to consumers as well as business partners: – Pre-defined users by contracts or agreements result in B2B-type sensor network services; and – Consumers by service subscription result in B2C-type sensor network services.

4.2 Analysis of service requirements

The following are service requirements for sensor network applications and services and these requirements are based on clause 5.1. These requirements are used to define functional requirements of sensor network reference architecture.

To be added or modified

[Editor's Note] This clause gives analysis of service requirements based on service model. This clause refers to ITU-T [Y.USN-reqts], "Requirements for support of Ubiquitous Sensor Network (USN) applications and services in NGN environment". These requirements lead to functional requirements defined in clause 6 and 7.

4.2.1 Connectivity

There are many types of sensor networks, such as IP-based, non IP-based, wired or wireless sensor networks. In IP-based sensor networks, every sensor node is capable for IP networking. Although the underlying wired or wireless media access control is tightly managing the connectivity of sensor nodes, connection between end user and a sensor network is through IP. In this sensor network type, it may happen that a single sensor

node may directly connect to the backend network without a gateway, although normal scenario would use gateway to interconnect sensor networks and access networks.

In non IP based sensor networks, sensor nodes do not have IP address, and the connection between end user and a sensor node is through sensor network gateways. The gateways interconnect sensor networks and access networks.

Therefore it is required to support connectivity between sensor networks and the backend network, regardless of sensor network type, i.e. IP based or non-IP based, wired or wireless sensor networks.

4.2.2 Sensor network management

IP based sensor networks and non-IP based sensor networks, and wired and wireless sensor networks can co-exist. Application level gateways or overlay IP networks can be used for the connectivity between sensor networks and the backend network, and the diverse types of sensor networks need to be managed.

4.2.3 Service registration and discovery

In order to discover the sensor network services, they should be registered beforehand. The association of senor network and sensor data should be registered to service registry. The registered services are needed to be discovered by applications or end-users.

4.2.4 Mobility support

The challenge of achieving mobility in sensor applications and services depends on the technologies used in the sensor networking. Existing IP mobility technologies can be adapted for IP-based sensor networks.

An example sensor network application scenario illustrating mobility requirements can be found in the healthcare application. For instance, a patient's medical check-up data may be monitored via a sensor network: several sensors may be attached to the patient, resulting in a body area sensor network. The sensors periodically gather the medical check-up data and send them to his/her doctor via a home-gateway when he/she is at home; while moving, the data can be sent via an access gateway in a network-enabled car, bus, train, or subway. Various cases of mobility may occur in such an application scenario.

[Editor's note] It is required to add more explanations on mobility support such as kinds of mobility and related requirements. Further contributions are invited.

4.2.5 QoS support

Mission-critical applications and services should be carefully managed. QoS may be a key technical issue in some scenarios. For example, emergency notification of fire in national treasure monitoring system must be delivered by time-critical and reliable way.

[Editor's note] It is required to define the scope of QoS support. During discussion, requirement of QoS support in this standard can be focused on sensor network area rather than delivery/core network area.

4.2.6 Security

In general, sensor network services highly require strong security, as the sensed data are very sensitive. There are various security issues which need consideration, such as protection against unauthorized use of network resources and unauthorized access to information and authentication of users.

5 Overview of the reference architecture of sensor network

[Editor's Note] In this clause, overview of the reference architecture and descriptions on components of the reference architecture will be given.

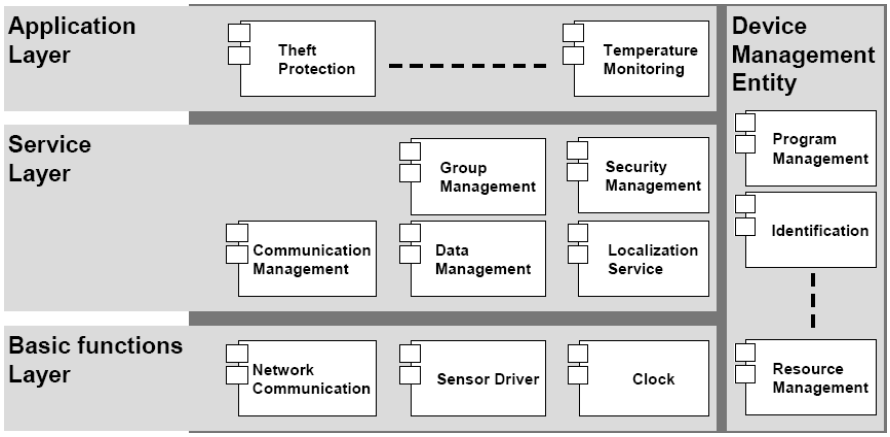

Figure 1 — Overview of the reference architecture *(just for reference and will be modified)*

[Editor's Note] Figure-1 is taken from ISO/IEC JTC1 SGSN N049 as a reference. This figure SHOULD be modified in this document. Contributions are required.

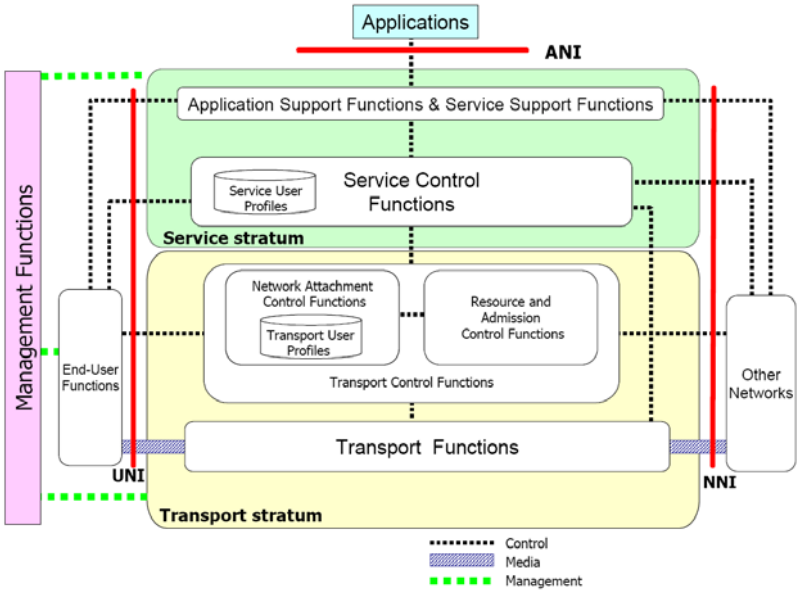

Figure 1-1 — NGN architecture overview *(just for reference and will be deleted)*

[Editor's Note] Figure 1-1 comes from ITU-T Y.2012, Next Generation Networks – Frameworks and functional architecture models – Functional requirements and architecture of the NGN of Release 1 as a reference. Overview of sensor network reference architecture may be given in the form of Figure 1-1. This figure should be deleted after figure 1 is created.

5.1 TBD

[Editor's Note] This clause will give descriptions on the overview of the reference architecture and the functionalities of components of the reference architecture based on service requirements defined in clause 4.2.

6 Generalized sensor network functional architecture

This clause explains the generalized functional architecture for the sensor network and defines the generalized functional entities. This architecture can be applied to general applications and services of sensor network. Also this architecture is technology-independent, therefore this architecture can be customized to respond to specific contexts in terms of the applications and services offered and the technologies used.

6.1 Sensor Network Functional Entities (FE)

In general, an FE is characterized by functions identified as sufficiently unique with respect to other FEs. In the case of the generalized sensor network architecture, the functional entities, called SN FEs, are to be understood as generic FEs to allow for their possible instantiation in more specific technology-oriented contexts. It is therefore possible that when SN FEs are instantiated, they can be used and can behave in a slightly different manner depending on the context. For example, this may lead to the case where at a given reference point (between the same SN FEs), the interface and the associated protocols are different depending on the instantiation. This means that interfaces, as well as protocol descriptions, can only be provided on the basis of a specific instantiation of the generalized functional architecture.

[Editor's Note] In this clause, Sensor Network Functional Entities (FE) will be given and the following is taken from ITU-T Y.2012, Next Generation Networks – Frameworks and functional architecture models – Functional requirements and architecture of the NGN of Release 1. The original sentences have NGN instead of sensor network or SN.

6.2 Generalized functional architecture

[Editor's Note] This clause will give generalized functional architecture showing all FEs and their relationships. Contributions are required.

Figure 2 — Sensor network generalized functional architecture *(To be defined)*

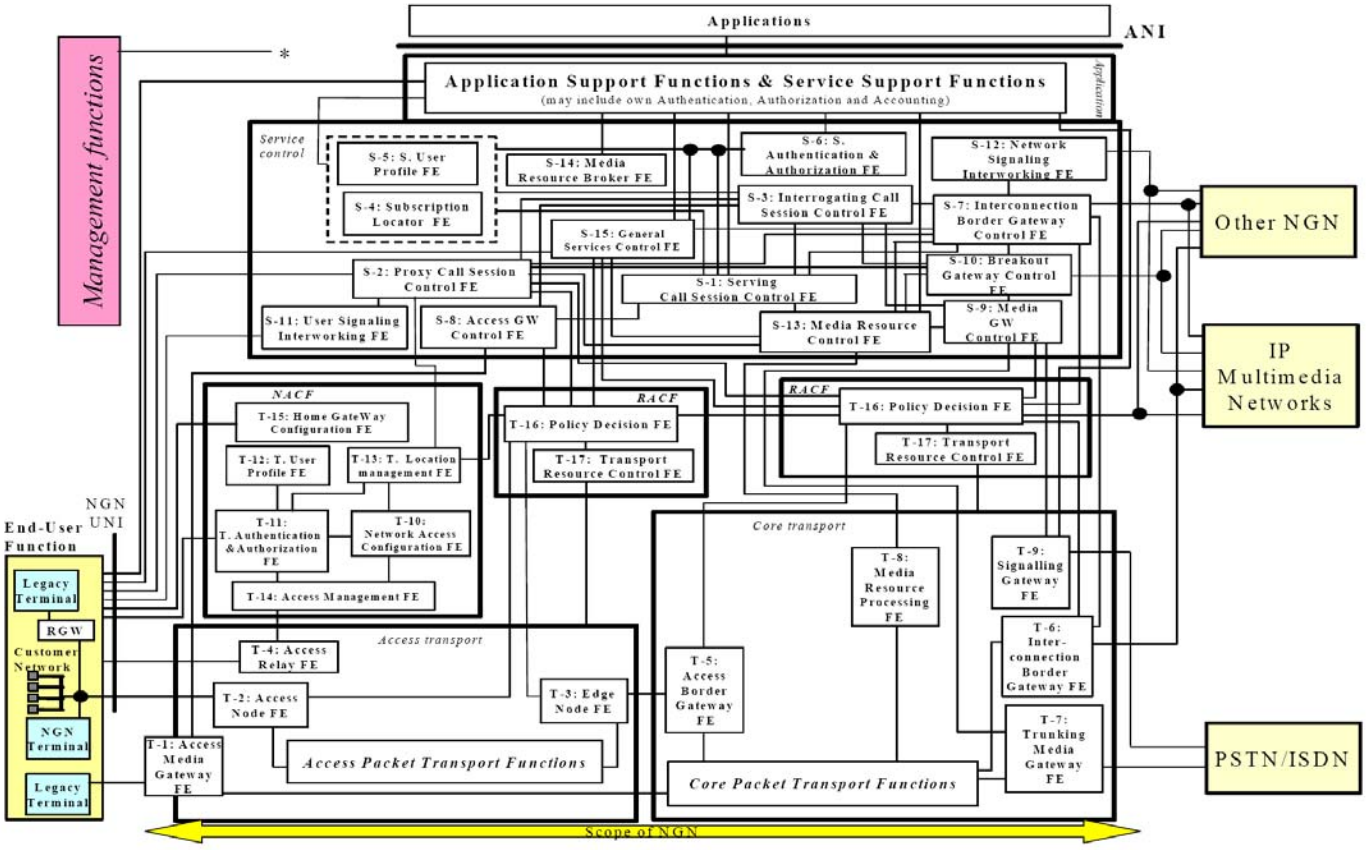

Figure 2-2 — NGN generalized functional architecture *(just for reference and will be deleted)*

[Editor's Note] For reference to generalized functional architecture, Figure 2-2 is taken from ITU-T Y.2012. Figure2-2 is derived from Figure 1-1. As shown in Figure 2-2, functional entities are placed in each function block defined in Figure 1-1.

In this WD, Figure 1 - Overview of the reference architecture should be extended to Figure 2 - Sensor Network generalized functional architecture in the similar form of Figure 2-2.

6.3 Functional entity descriptions

This clause describes each FE.

6.3.1 Basic function layer FEs

[Editor's Note] The title of this clause and following clauses should be changed according to Figure 1 and 2.

6.3.1.1 Network Communication FE (NC-FE)

[Editor's Note] This clause describes the functionalities and interfaces with other FE (if required) of each FE. The following is example of NGN generalized functional architecture.

The access media gateway functional entity (AMG-FE) provides interworking between the packet based transport used in the NGN and analogue lines or ISDN access.

a) It provides bi-directional media processing functions for user plane traffic between PSTN/ISDN and the NGN under the control of the AGC-FE.

b) It provides adequate transfer functions for PSTN/ISDN user call control signalling to the AGC-FE for processing.

c) It optionally supports payload processing functions (e.g., codecs and echo cancellers).

d) It optionally provides the TDM/IP interworking function to support ISDN emulation service in cases where an ISDN unrestricted bearer is needed.

6.3.1.2 … FE

6.3.1.3 … FE

6.3.2 Service layer FEs

[Editor's Note] The title of this clause and following clauses should be changed according to Figure 1 and 2.

6.3.2.1 … FE

6.3.2.2 … FE

6.3.2.3 … FE

6.3.3 Applications layer FEs

[Editor's Note] The title of this clause and following clauses should be changed according to Figure 1 and 2.

6.3.3.1 … FE

6.3.3.2 … FE

6.3.3.3 … FE

6.3.4 … FEs

[Editor's Note] The title of this clause and following clauses should be changed according to Figure 1 and 2.

6.3.3.1 … FE

6.3.3.2 … FE

6.3.3.3 … FE

Bibliography

[1] ISO/IEC Directives, Part 2, *Rules for the structure and drafting of International Standards*, 2004

[2] ISO/*IEC* JTC1 SGSN N049 (2009), *Technical Document of ISO/IEC JTC 1 Study Group on Sensor Networks (SGSN)*

[3] ITU-T Draft Recommendation Y.USN-reqts (2009), *Requirements for support of Ubiquitous Sensor Network (USN) applications and services in NGN environment (01. 2009)*

[4] ITU-T Y.101 (2000), *Global Information Infrastructure terminology: Terms and definitions*

[Editor's Note] To be added