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IoT reference architecture for Smart Nation

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NOTE

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Contents

Foreword

This Technical Reference (TR) was prepared by the Internet of Things Reference Architecture Working Group (RAWG) of the Internet of Things Technical Committee (IoT TC), under the direction of the IT Standards Committee (ITSC). The ITSC endorsed the TR on 7 March 2016.

While there are many smart cities around the world, Singapore, being a small country, can benefit from its compactness. It can take a holistic national view and not just a municipal one to muster the full resources of institutions, people and companies to deliver straight-forward and integrated services that will make a difference in citizens' lives.

In designing and implementing applications that support Smart Nation initiatives, IoT is foreseen as a key enabling technology to realise the solutions.

It is crucial for Singapore to have a set of guidelines and recommendations in the form of standards to aid architects and developers in the design, development and implementation of IoT systems which are interoperable and can integrate with other systems easily and efficiently to meet its Smart Nation's goals.

The TR is meant to serve as a reference for systems developers and implementers as they design system architectures for their target IoT application(s) and services. It also helps them to focus on the re-usability of structure and resources. Business users who are about to embark on IoT projects may also refer to this document for a high-level overview to gain some appreciation about IoT and Smart Nation.

This TR is a provisional standard made available for application over a period of two years. The aim is to use the experience gained to update the TR so that it can be adopted as a Singapore Standard. Users of the TR are invited to provide feedback on its technical content, clarity and ease of use. Feedback can be submitted using the form provided in the TR. At the end of the two years, the TR will be reviewed, taking into account any feedback or other considerations, to further its development into a Singapore Standard if found suitable.

NOTE – Due to changes in the industry landscape, this TR may be revised earlier than the typical two-year review period if deemed necessary.

In preparing this TR, reference was made to the following publications:

1) ISO/IEC 29182-2:2013 Information technology – Sensor networks: Sensor Network Reference Architecture (SNRA) – Part 2: Vocabulary and terminology

2) ISO/IEC 10746-2:2009 Information technology – Open distributed processing – Reference model: Foundations

Some terms in Clause 3 of this TR are based on ISO/IEC 29182-2:2013 and are reproduced with permission from the International Organization for Standardization.

Acknowledgement is made for the use of information from the above publications.

Attention is drawn to the possibility that some of the elements of this Technical Reference may be the subject of patent rights. Enterprise Singapore shall not be held responsible for identifying any or all of such patent rights.

Technical Reference for IoT reference architecture for Smart Nation

0 Introduction

0.1 Vision of a Smart Nation

Singapore is implementing a bold plan to take advantage of advanced technologies, a highly talented pool of people and highly connected and wired-up infrastructure, to make a quantum leap forward, to improve the lives of its citizens and to become the world's first Smart Nation.

Some of these Smart Nation focus areas include, but are not limited to, addressing the challenges of an ageing population and being densely populated as well as becoming a safe and secure data market place where individuals or companies can innovate to develop impactful applications and disruptive technologies. To this end, Singapore is implementing a set of Smart Nation initiatives. These initiatives include Internet of Things (IoT), smart robotics, big data, cloud computing, etc. Concurrently, concerted efforts are also being made in the areas of data governance, protection and sharing, as well as in cyber-security. The end goals of the Smart Nation initiatives are to build an anticipatory government, provide an array of integrated city services and empower its citizens with rich data insights to improve lives.

0.2 Use of IoT for Smart Nation initiatives

The key strength of IoT is that it helps to blend the physical environment and objects with traditional Information and Communication Technology (ICT) systems so that they can interact with one another seamlessly. IoT encompasses many supporting technologies such as sensing and control technologies, networking technology, information technology, software technology, etc. Together, all these technologies enable sensors, actuators, middleware, data and communication networks, and applications, to interconnect to form an IoT ecosystem. Some of the possible IoT applications and services include, but are not limited to:

– smart homes/buildings;

– intelligent transportation and traffic;

– tele-health; and

– environment monitoring systems.

Annex A provides a pictorial view of some possible IoT applications and Annex B provides some scenarios of IoT application deployment.

0.3 Standards for Smart Nation

There will be many aspects and technologies to be considered for an IoT ecosystem. IoT systems are composed of physical objects and virtual objects where both objects together mean 'things' in 'Internet of Things'. Data are sensed or collected by the sensor networks formed by sensors, processed and/or exchanged among different components of the IoT systems. The strength of an IoT system lies in its ability to further process, filter and fuse collected data into meaningful information, to make sense of the information, and/or to act/react to the situations upon the user's request or autonomously.

At present, there is no lack of IoT-related standards or interoperable sensor network systems and services globally. However, there is a need for a blueprint on how various disparate standards can be leveraged to guide the design, development and implementation of an ecosystem of interoperable sensor network devices and systems. As Singapore is embarking on a journey to implement many IoT systems to improve its citizens' lives, create more business opportunities, and provide integrated government services, Singapore Standards and Technical References are being developed as shown in Figure 1.

Figure 1 shows the suite of IoT standards for Smart Nation. It shows how various sets of standards are positioned in support of developing different IoT or sensor network applications for Smart Nation.

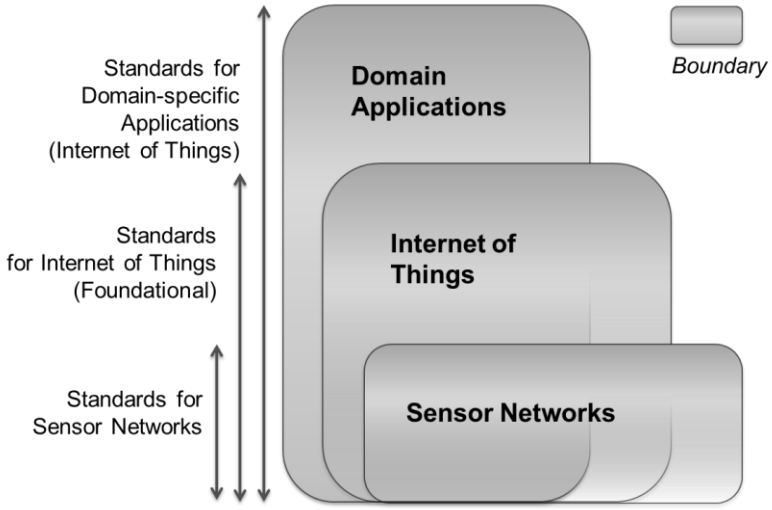

Figure 1 – Suite of IoT standards for Smart Nation

Standards for Smart Nation are clustered into three groups as follows:

- Standards for sensor networks that aim to provide recommendations on the communication and application interface standards for the development and deployment of sensor network(s) for different environmental settings. The settings include, but are not limited to public areas and homes.

- Standards for IoT (foundational) that provide information on basic building blocks which aid the development of cross-domain IoT systems for sharing information and the use of instrumentation. This TR is one of such standards.

- Standards for domain-specific applications (Internet of Things) that focus on specific vertical domains such as healthcare and intelligent transportation.

1 General

1.1 Scope

This TR aims to specify a technology-independent reference architecture in support of the development of specific architectures for applications or systems for IoT or sensor networks which are interoperable with each other through a set of well-defined interfaces to achieve seamless data exchange and information use. It describes the following:

– an IoT reference framework;

– a set of design principles;

– a set of general architectural requirements;

– an IoT reference model; and

– an IoT reference architecture (IoT RA).

This TR does not prescribe any specific method for implementing IoT systems and it does not recommend any specific standards for implementation.

1.2 Objectives

This TR is intended to:

– promote an open and common guiding architecture that facilitates the design and development of interoperable IoT systems to support Singapore's Smart Nation initiatives;

– promote modularity in the components of IoT systems, so that they can be easily added to or removed from larger IoT systems and

– guide the development of other IoT standards for Smart Nation.

2 Normative references

There are no normative references cited in this TR.