GUIDELINE ON SMART SUSTAINABLE CITIES STANDARDISATION FRAMEWORK IN RELATIONS TO INFORMATION AND COMMUNICATION TECHNOLOGIES (ICT) ASPECTS

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Abbreviations

For the purposes of this Guideline, the following abbreviation applies.

EMF	Electromagnetic Field
GIS	Geographic Information System
ICT	Information and Communications Technology
IoT	Internet of Things
ISO	International Standard Organisation
ITU	International Telecommunications Union
OAM & P	Operation, Administration, Maintenance and Provisioning
PON	Passive Optical Network
RFID	Radio Frequency Identification
SAC	Standardisation Administration of China
SSC	Smart Sustainable Cities
SDO	Standard Development Organisation
WPAN	Wireless Personal Area Networks

Definitions

For the purposes of this Guideline, the following definitions applies.

Smart Sustainable City	A Smart Sustainable city is an innovative city that uses information and communications technology (ICT) and other means to improve quality of life, efficiency of urban operation and services, and competitiveness, while ensuring that it meets the needs of present and future generations with respect to economic, social, environmental as well as cultural aspects.
Internet of Things (IoT)	A global infrastructure for the information society, enabling advanced services by interconnecting (physical and virtual) things based on existing and evolving interoperable information and communications technologies.
Device	With regards to the IoT, this is a piece of equipment with the mandatory capabilities of communication and the optional capabilities of sensing, actuation, data capture, data storage and processing.
Thing	With regards to the IoT, this is an object in the physical world (physical things) or the information world (virtual things), which is capable of being identified and integrated into communications network.

1. Scope

This guideline has been prepared to provide standardisation framework for activities with regards to the development of standards for smart sustainable cities (SSC), with a specific focus on Information and Communications Technology (ICT) layer. This standardisation framework aims to assist various stakeholders from government and non-government bodies, agencies and organisations, as well as industry and academia in working together for development of smart sustainable cities in Malaysia

2. Normative References

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

See Annex A.

3. Background

3.1 Requirements

The concept of Smart Cities has risen from the emerging urbanism phenomenon across the globe, according which the proportion of the international population that will live in cities will exceed 66% in 2050[1].

Malaysia is currently in the stage of shifting from an emerging market to a developed market, and 'smart solutions' are seen as the key towards growth. This developed market-goal is supposed to be reached by 2020, and outside resources are essential to enable smart cities and communities in Malaysia.

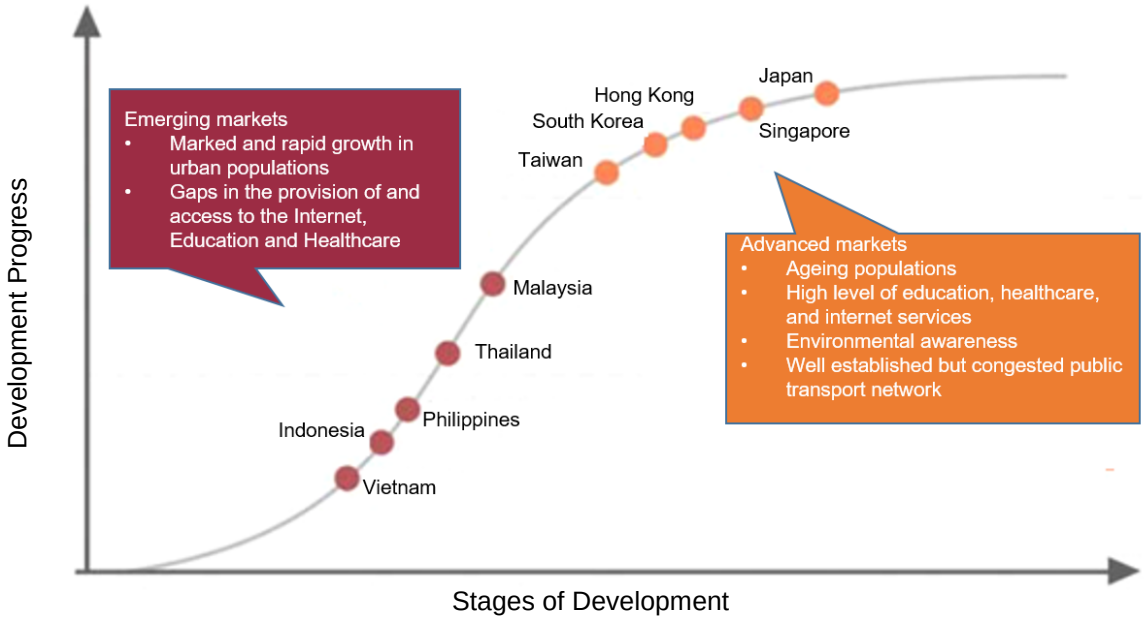

Figure 1. Malaysia's regional position on shifting towards advanced markets[2]

[1] World Urbanisation Prospect 2014. Department of Economics and Social Affairs, United Nations.

[2] AT Kearney Analysis

The previously given definition provides this document with the following characteristics for a smart sustainable city:

It concerns an urban space with innovative - not necessarily based on ICT- features. However, the context of smart cities and communities in this document focuses on architecture of which ICT have a crucial role amongst the other innovative solutions and city facilities.

These innovation solutions address the following urban dimensions:

a) Society - to deliver today and future generations' requirements, by enhancing wellbeing, spiritual and social coherency, as well as efficiency regarding energy, food, water, etc.

b) Environment - to include protection, waste and emissions control against climate change.

c) Governance - to ensure urban utility and service availability.

d) Economy - in terms of sustainable growth, smart solutions to increase efficiency and productivity, and city competitiveness (attracting habitants, visitors and businesses).

3.2 Roles of Internet of Things as an Enabler for Smart Sustainable Cities

The Internet of Things (IoT) is a technology which has the potential of merging the physical world and the virtual world through providing the internetworking between devices (such as sensors and actuators) that interfaces with physical objects (such as vehicles, buildings and other “things”) with the powerful and disruptive computing world (such as the mobile, social, big data, cloud computing, machine intelligence and others) by virtue of their connectivity via the Internet. This leads to new scenarios that would not be possible before such as intelligent buildings, real time predictive analytics and control, smart manufacturing, autonomous vehicles, personal assistants and robots, high quality speech recognition and others.

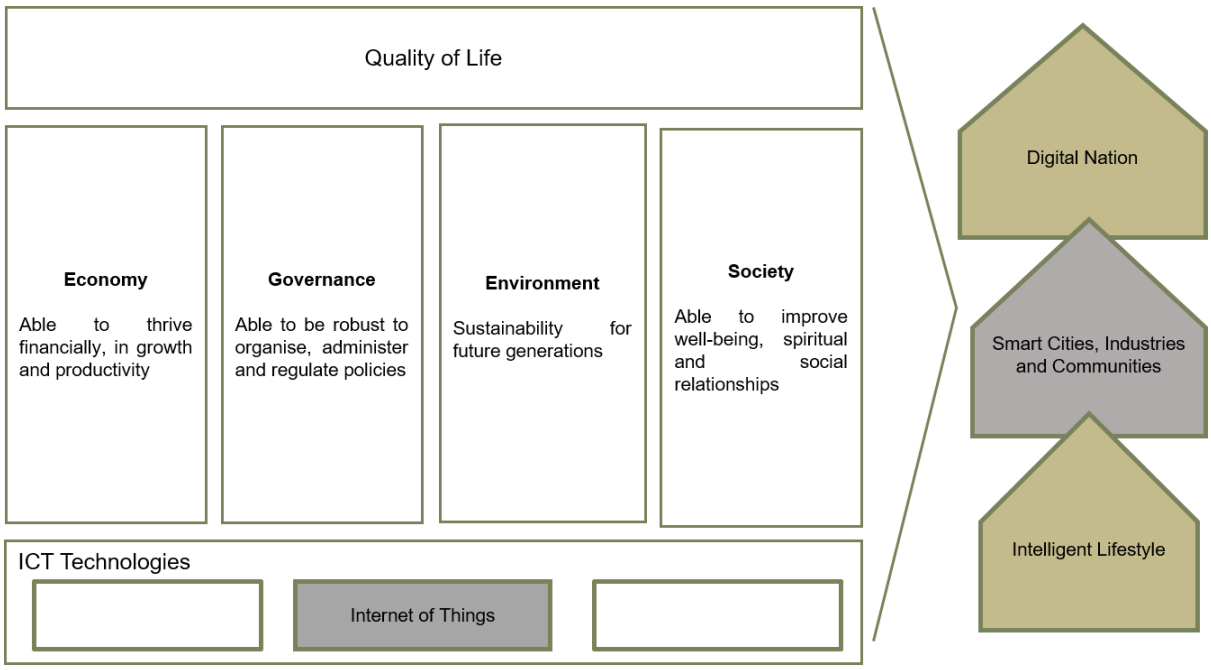

Figure 2. Internet of Things as a fundamental base in supporting Smart City vision

Figure 2 explains how IoT to serve as a fundamental base in supporting the smart city vision to increase quality of life by addressing four (4) dimensions of city as described previously. This

ecosystem is scalable from a micro-level Intelligent Lifestyle, in which devices are connected at a personal level. When several personal level connected devices interact among each other and the surrounding devices, this ecosystem is termed Smart Cities and Communities. As cities-wide network and devices interact among other cities at a country-wide scale, this ecosystem is termed Digital Nation.

3.3 Infrastructure Classifications for Smart Sustainable Cities

Smart city infrastructure can be classified according to the type and corresponding development stage to the following categories:

a) Hard infrastructure - this category refers to physical infrastructure – ICT or non-ICT based – to address issues such as mobility/transport, basic amenities and utilities such as water, waste, and energy, as well as internet and broadband connectivity and coverage.

b) Soft infrastructure - this category refers to non-physical aspects of requirements such as human capital, knowledge and IT literacy, social adaptation and inclusion, privacy and trust, as well as effective policies and planning.

3.4 Smart Sustainable Cities Stakeholders

As defined in ITU-T publications on Smart Cities ITU TR SSC-0113, a stakeholder is defined as any entity, an institution or an individual, that has an interest in smart cities or that can significantly influence or be influenced by its deployment. As such, the following set of stakeholders has been identified:

a) Municipalities, City Council and city administration - this category refers to organisations that are responsible for city management and maintenance, and therefore are considered the local champion for smart initiatives.

b) National and regional governments - this category refers to national-level planners and policy makers that have direct or indirect impact on smart cities implementation.

c) City services companies - this category refers to city services organisations and operators which will be implementing smart city solutions and maintenance.

d) Utility providers - this category refers to utility providers which are directly related and impacted by implementations of smart city solutions such as smart grid or smart water management.

e) ICT Companies (Telecom Operators, Start-ups, Software Companies) - this category refers to solution providers or system integrators for ICT infrastructures, platform and integrated solutions.

f) Non-Government Organisations (NGOs) - this category refers to non-profit non-governmental organisations that support the smart city vision, which plays an important role in influencing society and mobilising community especially on the axis of social sustainability.

g) International, Regional and Multilateral Organisations - this category refers to international agencies and multilateral organisations. These agencies can be promoters of initiatives towards human development, environmental sustainability and improvement of quality of life worldwide, as well as financing smart cities initiatives.

h) Industry associations - since industries are interested in the deployment of smart city, industry associations also work towards the success of this new model.

i) Academia, research organisations and specialised bodies - research and academic institutions involve in understanding smart city development, technology and associated trends, including its impacts and contributions to sustainable development.

j) Citizens and citizen organisations - as users of cities, citizens are affected both directly and indirectly by smart city deployment.
k) Urban Planners - their expertise is important to better understand how to include ICTs into medium and long term city planning, as well as to consider urban complexities.

l) Standardisation bodies - these are critical to ensure a common terminology and minimum characteristics of a smart city, as well as to define measurement methods to assess the performance and sustainability of city services based on ICT technologies.

3.5 Characteristics Concerns of Smart Sustainable Cities

The previously identified context regarding needs, scope and stakeholders illustrate that there's a broad environment where the smart city ICT architecture has to be applied, which addresses:

a) Different geographic areas - various political, economic, technological, social and cultural characteristics**;**

b) Different technological artefacts - which potentially have been applied in the urban space (i.e., existing ICT solutions that have been developed by alternative stakeholders; public or private broadband networks, etc.);

c) Size and type of the city - such as small versus global cities and capitals; new versus existing cities accordingly, which differentiate the size of smart city ICT impact and availability requirements, as well as the capability to install various hard infrastructure (simple for new cities and blocks, compared to historical cities);

d) Different timeframes - within which the smart city ICT architecture is requested to operate, for which small communities change more slowly and their needs accordingly, compared to global cities.

3.6 Architecture Principle of a Smart Cities

The architectural principles that enable the smart city ICT architecture to align to the above characteristics concern:

a) Layered structure - layered architecture has been proved to be applied in the mostly well managed smart city cases and can be applicable to most cases. Some layers have already introduced by the ITU FG-SSC 0097 specifications document on SSC infrastructure such as, the data and communication layer. However, exceptions have to be considered in cases where the smart city is not centrally and simultaneously developed, such as many in European cases.

b) Interoperability - interoperability needs to be ensured among heterogeneous and distributed systems in SSC for provision and consumption of a variety of information and services.

c) Scalability - the smart city ICT architecture has to be able to scale-up and down according to the size of city, the demand for services or business changes within the SSC.

d) Flexibility - cutting-edge (i.e., cloud computing, IoT, etc.) and emerging technologies have been able to be adopted, while physical or virtual resources have to be rapidly and elastically adjusted to provide various types of smart city services.

e) Fault tolerant - many quality attributes concern themselves with the availability of the architecture and its hosted componentry. Although fault tolerance is a rather strong phrase, it states the apex to which services and the architecture should aspire.

f) Availability, manageability and resilience - service availability must be ensured according the SSC user demand; disaster recovery must be provided in various levels; manageability relates to operational concerns, in a sense that managing the architecture directly supports smart city ICT operations. Manageability -at a systems/subsystems level- has to be secured in order to allow normal operations of equipment, networks and applications, especially considering more and more operation process would be managed automatically.

g) Standards-based - this principle has an identifiable tension with that of technology and vendor independence. Essentially, an organisation endorses this principle to ensure contestability, replace ability, and longevity.

h) Technology and/or vendor independence - SSC and mainly those that run under the State supervision and/or funding, require that architectures, solutions, or services be vendor-independent, to facilitate contestability, replacement, or simpler interoperability or integration. Vendor independence may also compromise one's ability to negotiate preferential rates or treatment, and it is not unusual for (larger) organisations to nominate a preferred list of suppliers for certain services, allowing a degree of negotiation to occur to support cost containment.

4. Standardisation Framework for Smart Sustainable Cities

A framework for Smart City standardisation initiative is imperative to provide clear demarcation of scope of roles and responsibility for participating standard development organisations.

A document on smart city standardisation framework has been published by the ITU FG-SSC 0097 specifications document on SSC infrastructure. This document has been referenced and adopted by several other major standard development organisations to include IEEE and ISO/IEC.

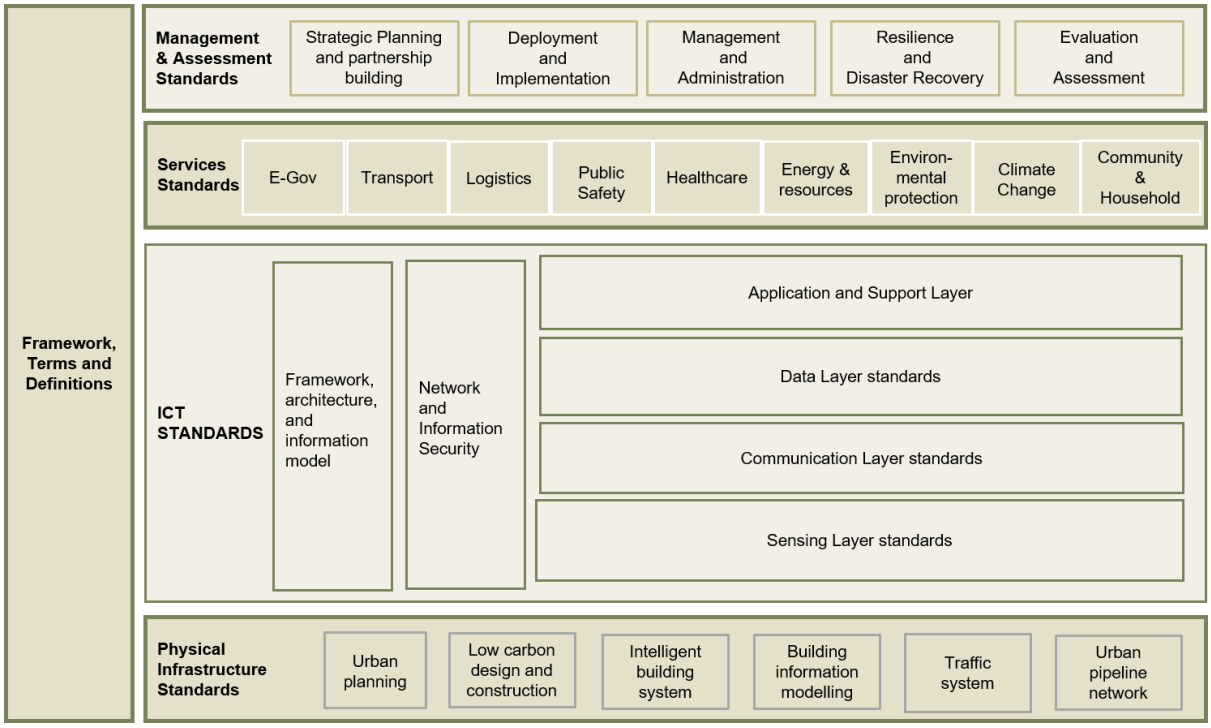

Figure 3. Smart City standardisation framework that is widely adopted by international standard development organisations[3]

Standards for Smart Sustainable Cities can be generally classified into four categories:

4.1 Management and assessment

4.1.1 Strategic planning, Business Model and Partnership Building

Work conducted within this area should cover the scope of business model, strategic planning and partnership building of SSC.

The tasks include, but are not limited to:

a) Developing a viable business model for smart sustainable cities initiatives.
b) Developing guidelines and best practices for the requirements analysis in SSC.
c) Developing guidelines and best practices for the strategic planning mechanisms and methods in SSC.
d) Developing guidelines and best practices for the partnership building mechanisms and methods in SSC.

4.1.2 Deployment and implementation

Work conducted within this area should cover the scope of deployment and implementation of SSC.

The tasks include, but are not limited to:

a) Developing guidelines and best practices for the deployment procedures in SSC.

[3] ITU-T Technical Reports and Specifications on Smart Sustainable Cities – Shaping smarter and more sustainable cities PART 5.1

b) Developing guidelines and best practices for the implementation procedures in SSC.

4.1.3 Management and administration

Work conducted within this area should cover the scope of management and assessment of SSC.

The tasks include, but are not limited to:

a) Developing a code of conduct for the management in SSC.
b) Developing a code of conduct for the administration in SSC.

4.1.4 Resilience and disaster recovery

The standardisation of the following areas should be implemented in the management and assessment of SSC.

The tasks include, but are not limited to:

a) Developing guidelines and best practices for the resilience in SSC.
b) Developing guidelines and best practices for the disaster recovery in SSC.

4.1.5 Evaluation and assessment

The standardisation of the following areas should be implemented in the management and assessment of SSC.

There are several technical report and technical specifications on key performance indicators of information and communication technologies for smart sustainable cities developed by FG SSC [ITU-T L. KPIs-overview] [ITU-T L.KPIs-ICT] [ITU-T L.KPIs-impact] [ITU-T L.KPIs-supp].

The task includes, but is not limited to developing Recommendations for the methodology of evaluation and assessment for SSC.

4.2 Smart City services

4.2.1 E-Government

The standardisation of e-government should support the services related to government affairs that are provided to city residents. The technologies of e-government include, but are not limited to, information sharing, electronic document sharing, and data directory service.

The tasks include, but are not limited to:

a) Developing guidelines for the services of e-government related to SSC that include: online city information availability, online civic engagement, online support for new city residents, strategies to enable ICT literacy of residents, etc.

b) Developing a series of technical standards including the terms and definitions, service models, information management, and safety and security, etc., in the e-government of SSC.

c) Providing the necessary collaboration for joint activities in this field between ITU-T and Standard Development Organisations (SDOs) conducting related work on SSC, consortia and forums.

There are some fundamental standards on information technologies in ISO/IEC, including:

a) Vocabulary;

b) Metadata registries;
c) Software product evaluation;
d) Security techniques (evaluation criteria for information technology (IT) security, digital signatures with appendix, entity authentication, non-repudiation); and
e) Open systems interconnection (security frameworks for open systems, systems management).

There are some fundamental standards on data exchange service, including:

a) Office automation;
b) Real-time information releasing;
c) Transparency around governmental decision-making and open data; and
d) Electronic public-opinion polling.

4.2.2 Transport

The standardisation of transport issues in SSC should fulfil the requirements of passengers, drivers, vehicles, traffic infrastructures, etc.

The services of city transport system include but are not limited to: traffic information services, traffic telematics, information exchange between vehicle to vehicle (V2V), vehicle to infrastructure (V2I), and vehicle to everything (V2X), and traffic emergency processing.

The tasks include, but are not limited to:

a) Developing guidelines for integrated services within SSC intelligent transport systems.

b) Developing Recommendations for guidelines and best practices related to the services and functional requirements of the traffic emergency processing for SSC.

c) Developing Recommendations for guidelines and best practices related to the implementation of SSC mobility and transport services with a view to addressing environmental challenges.

d) Providing the necessary collaboration for joint activities in this field between ITU-T and SDOs, consortia and forums conducting related work on SSC.

[ITU-T TR infrastructure] discusses ICT infrastructure in SSC which involves facilities of IoT. There are several technical committees (TCs) working on traffic/transport standardisation in ISO/IEC.

4.2.3 Logistics

The standardisation of logistics in SSC should fulfil the service requirements related to consignor, consignee, carriers, goods, and warehouses.

The tasks include, but are not limited to:

a) Developing guidelines for integrated services regarding logistics in SSC, including supply chain services, business intelligence, and electronic payments etc.

b) Developing Recommendations for guidelines and best practices related to the implementation of logistics services with a view to addressing environmental challenges.

c) Providing the necessary collaboration for joint activities in this field between ITU-T and SDOs conducting related work on SSC, consortia and forums.

The “GS1 Standard 1” focuses on the management of objects in the supply chain and is widely accepted as an international standard.

4.2.4 Public safety

The standardisation of public safety in SSC should fulfil the service requirements of citizens.

The services of public safety for SSC include, but are not limited to: crime reduction, tackling natural and man-made disasters, and emergency response.

The tasks include, but are not limited to:

a) Developing guidelines for services relating to public safety and security in SSC, including: crime reduction, anti-terrorism, disasters management, emergency response, etc.

b) Developing guidelines relating to measures and facilities of public safety and security in SSC, such as: flood control, fire control, food and drug quality tracing, etc.

c) Providing the necessary collaboration for joint activities in this field between ITU-T and SDOs, consortia and forums conducting related work on SSC.

4.2.5 Health care

The standardisation of health care in SSC should fulfil the service requirements of city residents, patients, hospitals, and health centres.

The services of health care include but are not limited to: e-health monitoring services, health informatics, medical informatics, and telemedicine.

The tasks include, but are not limited to:

a) Developing guidelines for services related to health care in SSC based on the existing health care related standards, including: electronic health records, electronic medical records, medical resources and information sharing, telemedicine, etc.

b) Developing guidelines for the system and interfaces with existing health care related standards.

c) Developing guidelines for the strategy of improving resident health such as: mitigation of exposure to the electromagnetic field (EMF), noise, pollution, etc.

d) Providing the necessary collaboration for joint activities in this field between ITU-T and SDOs, consortia and forums conducting related work on SSC.

WHO, CEN/TC 251, ISO/TC 215, ITU-T SG13, and ITU-T FG M2M are working on all aspects of health care standards covering areas from doctors and nurses to patients, from hospitals to home and electromagnetic field. These standards are widely used in the health care industry.

4.2.6 Governance of urban infrastructure

The standardisation of the governance of urban infrastructure in SSC should fulfil the service requirements of city infrastructures.
The city infrastructure includes but is not limited to: road transport, street lighting, urban landscape, and urban underground pipelines.

The tasks include, but are not limited to:

a) Developing guidelines for services related to urban governance in SSC based on the existing urban governance standards.

b) Developing guidelines for the system and interfaces based on the existing urban governance application in SSC.

c) Developing Recommendations for integrated management in SSC (high level requirements, framework, meta-model, data fusion, management services, cooperation in creation of infrastructure and sharing among service providers etc.).

d) Providing the necessary collaboration for joint activities in this field between ITU-T and SDOs, consortia and forums conducting related work on SSC.

There are some technical reports on integrated management and corresponding best practices in FG-SSC which concentrate on decision making, urban operations and services [ITU-T TR management] [ITU-T TR water].

ISO TC 268 is working on the management of smart community infrastructures. Also, some national organisations, such as The American Society of Civil Engineers (ASCE) and their counterpart in China (Standardisation Administration of China (SAC)), have this kind of standards and technical documents.

4.2.7 Energy and resources management

The standardisation of energy and resources management should fulfil the service requirements of industries, residential dwellings and public facilities related to energy and resources management in SSC.
The energy and resources management includes, but is not limited to: power supply, water supply and sanitation, oil supply, gas supply, and city minerals.

The tasks include, but are not limited to:

a) Developing guidelines for energy consumption in SSC (data collection, statistics, analysis, etc.).

b) Developing guidelines for resources supervision in SSC.

c) Developing guidelines for energy efficiency in SSC.

d) Developing Recommendations for methodology of energy evaluation in the household.

e) Providing the necessary collaboration for joint activities in this field between ITU-T and SDOs, consortia and forums conducting related work on SSC.

ISO, IEC and ITU-T are working on the smart grid and smart metering in energy and resources management as well as on energy efficiency. However, since the scope and boundary of the standards is not limited to the region of a city, more efforts related to integrated energy and resources management, including power, gas, water and sanitation in cities, are required.

4.2.8 Environmental protection

The standardisation of environmental protection should fulfil the service requirements of industries and residential dwellings related to environmental protection in SSC.

The services of environmental protection include but are not limited to: EMF, solid waste management, e-waste management, pollution source monitoring, toxic substance monitoring, and noise monitoring.

The tasks include, but are not limited to:

a) Developing Recommendations for integrated environmental assessment in SSC (EMF, solid waste management, e-waste management, pollution source monitoring, toxic substance monitoring, noise monitoring).

b) Developing guidelines for exposure to environment pollution (EMF, chemicals, radiation, noise, etc.).

c) Providing the necessary collaboration for joint activities in this field between ITU-T and SDOs, consortia and forums conducting related work on SSC.

4.2.9 Climate change adaptation

Standardisation related to climate change should fulfil the service requirements of industries related to climate change in SSC.

The services of ICT and climate change for SSC include, but are not limited to: tackling climate change in cities.

The tasks include, but are not limited to:

a) Developing guidelines for climate change assessment (adaption and mitigation) in SSC.

b) Developing guidelines for ICT use in Green House Gas (GHG) emissions.

c) Providing the necessary collaboration for joint activities in this field between ITU-T and SDOs, consortia and forums conducting related work on SSC.

4.2.10 Community and household

Standardisation related to districts should fulfil the service requirements of residents, and communities in SSC.

The tasks include, but are not limited to:

a) Developing Recommendations for smart districts, including scenarios, use cases, best practices, and security etc.

b) Developing Recommendations for smart communities with linkage to e-government, public safety, emergency response, healthcare, energy and resources management, etc.

c) Providing the necessary collaboration for joint activities in this field between ITU-T and SDOs, consortia and forums conducting related work on SSC.

4.3 Information and communication technology (ICT)

4.3.1 ICT framework, architecture and information model

The standardisation of SSC framework, architecture and information model should be based on and as an expansion of the related ICT standards, supporting the development of SSC.

The tasks include, but are not limited to:

a) Developing ITU-T Recommendations for:

    i. Terms and definitions related to SSC from an ICT perspective;

ii. Characteristics, high-level requirements and general capabilities of SSCs;
iii. Information model of SSC from a spatio-temporal perspective; and
iv. ICT infrastructure/services available in SSC/ architecture framework and technical requirements of SSC.

b) Developing ITU-T Recommendations on: guidelines, methodologies and best practices to help cities to deliver ICT services including (but not limited to) integrated management, IoT, big data and open data with a view to addressing social, economic, and environmental challenges.

c) Providing the necessary collaboration for joint activities in this field between ITU-T and SDOs, consortia and forums conducting relevant work on SSC.

There are several technical reports on SSC terms and definitions, characteristics and attributes, and infrastructure which concentrate on ICT infrastructure in FG SSC [ITU-T TR SSC Def] [ITU-T TR overview] [ITU-T TR infrastructure].

4.3.2 Network and information security, availability and resilience

The standardisation of network and information security should be based on and expand the related ICT standards, supporting the security requirements of SSC.

The task includes but is not limited to developing the guidelines for network and information security in SSC.

4.3.3 Application and support layer

The standardisation of the following technologies should be implemented in the application and support layer of SSC:

a) Service Oriented Architecture (SOA);
b) Information presence;
c) Integrated management; and
d) Decision-making.

The tasks include, but are not limited to:

a) Developing guidelines for the interface of application and support layer standards in SSC; and

b) Developing guidelines for three dimensional (3D) virtual reality of SSC, city simulation, web services for SSC, etc.

4.3.4 Data layer

The standardisation of the following technologies should be implemented in the data layer of SSC:

a) Cloud computing;
b) Data exchange; and
c) Geographic Information System (GIS)

The tasks include, but are not limited to:

a) Developing guidelines for the interface of data layer standards in SSC.

b) Developing Recommendations for the future needs of big data, open data etc. supporting various SSC services.

4.3.5 Communication layer

The standardisation of the following technologies should be implemented in the communication layer of SSC:

a) Ethernet;
b) xDigital Subscriber Line (xDSL);
c) Ethernet Passive Optical Network (EPON) / Gigabit Passive Optical Network (GPON);
d) Synchronous Digital Hierarchy (SDH) / Dense Wavelength Division Multiplexing (DWDM) / Optical Transport Network (OTN);
e) Global System for mobile Communications (GSM) / Wideband Code Division Multiple Access (WCDMA) / Code Division Multiple Access (CDMA);
f) Long Term Evolution (LTE) Time Division Duplex (TDD) / Frequency Division Duplex (FDD); and
g) EMF

4.3.6 Sensing layer

The standardisation of the following technologies should be implemented in the sensing layer of SSC:

a) IEEE 1451 Smart Transducer Interface;
b) ISO/IEC JTC 1 SC 31 and AIM PDF417 Barcode Symbols;
c) ISO/IEC JTC 1 SC 31 and Electronic Product Code (EPC) global radio frequency identification (RFID);
d) ZigBee;
e) IPv6 over low power wireless personal area networks (6LoWPAN);
f) Wireless MBus;
g) Global positioning system (GPS);
h) Video surveillance; and
i) Smart metering.

The tasks include, but are not limited to developing guidelines for:

a) The application of smart transducer interface in SSC.
b) The interface of barcode symbols in SSC.
c) The interface of RFID in SSC.
d) The gateway of ZigBee/6LoWPAN in SSC.
e) The gateway of Wireless MBus.
f) The interface of Global Positioning System in SSC.
g) The application of video surveillance in SSC.
h) The interface of smart metering with related services in SSC.

4.4 Buildings and physical infrastructure

4.4.1 Urban planning

The standardisation of the following technologies should be implemented in the urban planning of SSC:

Building SSC from an urban planning perspective

Tasks include but are not limited to:

a) Developing guidelines and best practices for urban planning in SSC; and

b) Developing guidelines for the essential technologies for urban planning such as GIS, electronic maps.

4.4.2 Low carbon design and construction

The standardisation of the following areas should be implemented in the low carbon design and construction of SSC:

a) Energy conservation; and
b) Waste recycling.

The tasks include, but are not limited to:

a) Developing guidelines and best practices for energy conservation in buildings and physical infrastructure.

b) Developing guidelines and best practices for waste recycling in buildings and physical infrastructure.

4.4.3 Intelligent building systems

The standardisation of the following technologies should be implemented in the intelligent building systems of SSC:

Synergy of intelligent building systems with related ICT systems in SSC.

The tasks include, but are not limited to:

a) Developing Recommendations regarding the interface of intelligent building systems with related ICT systems in SSC.

b) Developing guidelines and best practices for the ICT use for intelligent building systems in SSC.

4.4.4 Building information modelling (BIM)

The standardisation of the following areas should be implemented in the building information modelling of SSC:

Synergy of building information modelling with related ICT systems in SSC.

The tasks include, but are not limited to:

a) Developing Recommendations regarding the interface of building information modelling with related ICT systems in SSC including GIS, navigation, wireless telecommunication, etc.

b) Developing guidelines and best practices for the ICT use for building information modelling in SSC.

4.4.5 Traffic systems

The tasks include, but are not limited to:

a) Developing guidelines for building intelligent transport system in SSC.

b) Developing Recommendations and best practices related to the implementation of intelligent transport system with a view to addressing environmental challenges.

c) Providing the necessary collaboration for joint activities in this field between ITU-T and SDOs conducting related work on ITS.

4.4.6 Urban pipeline network

The standardisation of the following technologies should be implemented in the urban pipeline of SSC:

a) Urban pipeline information; and

b) City geo-information infrastructure.

Urban pipelines are usually considered as the lifeline of cites for piped water, sewage, drainage, sanitation, electricity, heating, telecommunications, gas and waste, etc.

The tasks include, but are not limited to:

a) Developing guidelines and best practices for the urban pipeline informatization in SSC.

b) Developing Recommendations for the integrated management of pipeline networks including:

   i. Terms and definitions;
   ii. Characteristics, high-level requirements and general capabilities;
   iii. Information model from spatial-temporal perspective;
   iv. Architecture framework and technical requirements.

There are several technical reports on infrastructure, integrated management, and smart water management in FG SSC [ITU-T TR infrastructure] [ITU-T TR management] [ITU-T TR water].

5. ICT Architecture for Smart City

Previous chapters have described the requirements and standardisation framework for smart city initiative. In this chapter, the framework on ICT architecture is being discussed in focus. In reference to a document published at the ITU entitled “Setting the framework for an ICT architecture of a smart sustainable city”, the ICT architecture can be seen from several perspectives

5.1 Physical ICT Communications Perspective

In this document, only the ICT architecture from the communications perspective is being highlighted. Figure 4 shows a corresponding SSC ICT architecture emphasizing on the communications perspective.

5.1.1 Sensing layer

This consists of terminal node and capillary network. Terminals (sensor, transducer, actuator, camera, RFID reader, barcode symbols, GPS tracker, etc.) sense the physical world. They provide the superior "environment-detecting" ability and intelligence for monitoring and controlling the physical infrastructure within the city.

The capillary network (including Supervisory Control and Data Acquisition (SCADA), sensor network, Highway Addressable Remote Transducer (HART), WPAN, video surveillance, RFID, GPS related network, etc.) connects various terminals to network layer, providing ubiquitous and omnipotent information and data.

5.1.2 Network layer

The network layer indicates various networks provided by telecommunication operators, as well as other metro networks provided by city stakeholders and/or enterprise private communication network. It is the "infobahn", the network layer data and support layer: The data and support layer makes the city "smarter", its main purpose is to ensure the support capabilities of various city-level applications and services.

Data and support layer contains data center from industries, departments, enterprises, as well as the municipal dynamic data center and data warehouse, among others, established for the realization of data process and application support.

5.1.3 Application layer

The application layer includes various applications that manage the SSC and deliver the SSC services.

5.1.4 Operation, Administration, Maintenance and Provisioning, and Security (OAM & P and security)

This provides the operation, administration, maintenance and provisioning, and security function for the ICT systems of SSC.

5.2 Interfaces between layers

Figure 4 shows also, six interfaces between layers and OAM & P and security framework, marked with numbers in circles. These are places where communications and exchange of information between the layers, and OAM & P and security framework take place. They are the focal point of standards specifications and thus are called communication interface point. Overall functions at each of these reference points are listed below:

5.2.1 Communication interface point 1

This exists between the city physical infrastructure and sensing layer. It enables the terminals sense the physical world, i.e., exchange of information and control signals between terminal nodes in sensing layer and the physical infrastructure.

5.2.2 Communication interface point 2

This exists between the terminal nodes in sensing layer and the network layer. In this case terminal nodes, directly or through net gates, access to the network layer without through capillary network.

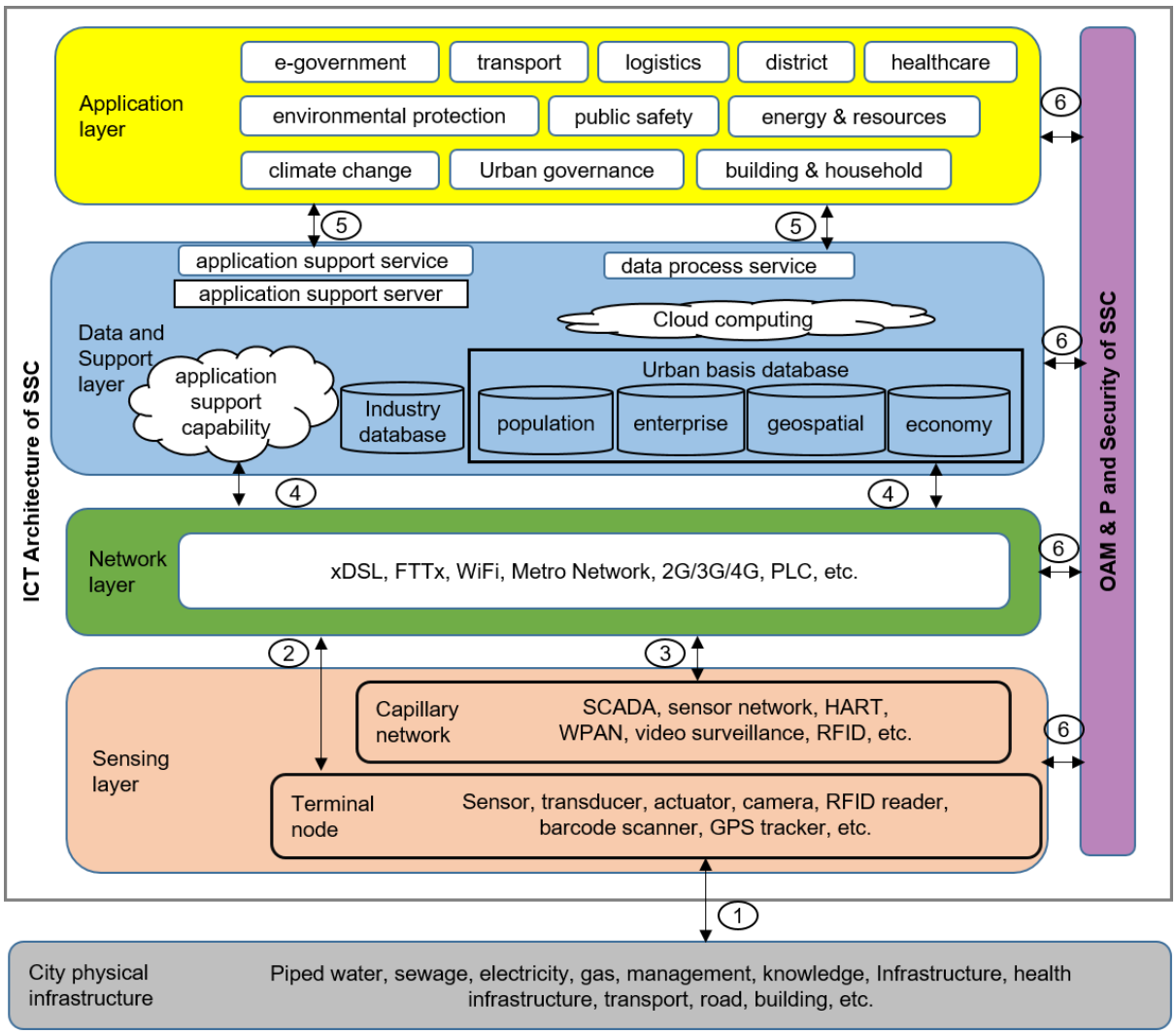

Figure 4. A multi-tier SSC ICT architecture from communications view, emphasizing on a physical perspective[4]

5.2.3 Communication interface point 3

This exists between the capillary network in sensing layer and the network layer. In this case, capillary networks collect the sensing data, and connects to the communication networks.

5.2.4 Communication interface point 4

This exists between the network layer and the data and support layer. It enables communications between data centers and lower layers for collecting various information through the communication networks.

5.2.5 Communication interface point 5

This point exists between the data and support layer and the application layer. It enables data centers and/or application support functionalities providing information to corresponding city applications and

[4] ITU-T Technical Reports and Specifications on Smart Sustainable Cities – Setting the framework for an ICT architecture of a smart sustainable city

services, and also enables integrated applications exchanging data via data centers and/or application support functionalities.

5.2.6 Communication interface point 6

This exists between the OAM & P and security framework and the four layers. It enables the corresponding modules to exchange data flow and control flow and provide operation, administration, maintenance, provisioning and security function.

6. Contacting MCMC & MTSFB

For any queries and further information on these Guidelines kindly contact:

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Annex A
(normative)

Normative References

ITU-T Technical Reports and Specifications on Smart Sustainable Cities – Shaping smarter and more sustainable cities PART 5.1

ITU TR SSC-0113, *Technical Report on Setting the stage for stakeholders' engagement in Smart Sustainable Cities*

ITU-T TR SSC Def, *Technical Report on smart sustainable cities: an analysis of definitions (2014).*

ITU-T TR overview, *Technical Report on an overview of smart sustainable cities and the role of information and communication technologies (2014).*

ITU-T TR infrastructure, *Technical Report on overview of smart sustainable cities infrastructure.*

ITU-T TR water, *Technical Report on smart water management in cities (2014).*

ITU-T L.KPIs-overview, *Technical Specifications on overview of key performance indicators in smart sustainable cities (2014).*

ITU-T L.KPIs-ICT, *Technical Specifications on key performance indicators related to the use of information and communication technology in smart sustainable cities.*

ITU-T L.KPIs-impact, *Technical Specifications on key performance indicators related to the sustainability impacts of information and communication technology in smart sustainable cities.*

ITU-T L.KPIs-Supp, *Technical Report on key performance indicators definitions for smart sustainable cities.*

ITU-T TR climate, *Technical Report on information and communication technologies for climate change adaptation in cities.*

ITU-T TR management, *Technical Report on integrated management for smart sustainable cities.*

ITU-T TR security, *Technical Report on cyber-security, data protection and cyber-resilience in smart sustainable cities*

ITU FG-SSC 0097, *Technical Report on Overview of Smart Sustainable Cities infrastructure*

IEEE 1451, *Smart Transducer Interface*

IEEE 802.15.4, *Low Rate Wireless Personal Area Networks*

IEEE 802.3, *Ethernet*

IETF 6LoWPAN, *IPv6 over low power wireless personal area networks*

Smart City standardisation Framework

Setting the framework for an ICT architecture of a smart sustainable city

Annex B
(normative)

Relevant Organisations / Working Group

3rd Generation Partnership Project (3GPP)

3rd Generation Partnership Project 2 (3GPP2)

American Society of Civil Engineers (ASCE)

CEN/CENELEC/ETSI, Joint Working Group on Smart Grid

CEN/CENELEC/ETSI, Joint Working Group on Smart Meters

CEN/TC 251, Health informatics

Distributed Management Task Force (DMTF)

Globe Standard 1

Healthcare Level 7 (HL7)

IEC TC 57, Power systems management and associated information exchange

IEC TC 108, Safety of electronic equipment

IEC/SMB SEG 1, Systems Evaluation Group - Smart Cities

ISO Climate Change Coordinating Committee (ISO CCCC)

ISO International Workshop Agreement (IWA), International harmonized method(s) for a coherent quantification of CO2e emissions of freight transport

ISO/IEC JTC 1/SG 1, Information Technology/Smart Cities

ISO/IEC JTC 1/SC 31, Automatic identification and data capture techniques and AIM

ISO/IEC JTC 1/SC 31 and EPC global

ISO/IEC JTC 1/SC 27, Information Technology/Security techniques

ISO/PC 248, Sustainability criteria for bioenergy

ISO/PC 283, Occupational health and safety management systems

ISO/TC 5, Ferrous metal pipes and metallic fittings

ISO/TC 22, Road vehicles

ISO/TC 30, Measurement of fluid flow in closed conduits

ISO/TC 59, Buildings and civil engineering works

ISO/TC 68, Financial services

ISO/TC 85, Nuclear energy, nuclear technologies, and radiological protection

ISO/TC 115, Pumps

ISO/TC 131, Fluid power systems

ISO/TC 138, Plastics pipes, fittings and valves for the transport of fluids

ISO/TC 153, Valves

ISO/TC 163, Thermal performance and energy use in the built environment

ISO/TC 176, Quality management and quality assurance

ISO/TC 180, Solar energy

ISO/TC 204, Intelligent transport systems

ISO/TC 205, Building environment design

ISO/TC 205/WG3, Building environment design/Building Automation and Control System (BACS) Design

ISO/TC 207, Environmental management

ISO/TC 211, Geographic information and Geomatics

ISO/TC 213, Dimensional and geometrical product

ISO/TC 215, Health informatics

ISO/TC 222, Personal financial planning

ISO/TC 223 Societal security

ISO/TC 224, Service activities relating to drinking water supply systems and wastewater systems - Quality criteria of the service and performance indicators

ISO/TC 238, Solid biofuels

ISO/TC 241, Road traffic safety management systems

ISO/TC 242, Energy Management

ISO/TC 255, Biogas

ISO/TC 257, Evaluation of energy savings

ISO/TC 265, Carbon dioxide capture, transportation, and geological storage

ISO/TC 268, Sustainable development in communities

ISO TC 268/SC 1, Sustainable development in communities/ Smart community infrastructures

ISO/TC 275, Sludge recovery, recycling, treatment and disposal

ISO/TC 282, Water re-use

ISO/TMB SAG Cities, Strategic Advisory Group on Smart Cities

ITU-T CITS, Collaboration on ITS Communication Standards

ITU-T FG CarCom, Focus Group on From/In/To Cars Communication

ITU-T FG Distraction, Focus Group on Driver Distraction

ITU-T FG DR&NRR, Focus Group on Disaster Relief Systems, Network Resilience and Recovery

ITU-T FG M2M, Focus Group on Machine-to-Machine Service Layer

ITU-T FG Smart Grid, Focus Group on Smart Grid

ITU-T Q12/SG13, Distributed service networking

ITU-T Q25/SG16 IoT application and services

ITU-T Q27/16, Vehicle gateway platform for telecommunication/ITS services /applications

ITU-T Q4c/SG15, PEV communications

ITU-T SG2, Operational aspects of service provision and telecommunications management

ITU-T SG5, Environment and climate change

ITU-T SG13, Future networks, including cloud computing, mobile and next-generation networks

ITU-T SG15, Networks, technologies and infrastructures for transport, access and home

ITU-T SG17, Security.

ITU-T WP3/SG5, ICT and climate change

Network Video Interface Forum

Open Geospatial Consortium (OGC)

Physical Security Interoperability Alliance

Standardization Administration of China (SAC)

SAC/TC426, Digital Technique of Intelligent Building and Residence Community

Special Interest Group for Computer GRAPHICS (SIGGRAPH)

The United Nations Framework Convention on Climate Change (UNFCCC)

World Wide Web Consortium (W3C)

World Health Organisation (WHO)

ZigBee Alliance