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Abstract:

This document presents the annual deliverable for Question 1/2 “Creating smart cities and society: Employing information and communication technologies for sustainable social and economic development” for the period 2018-2019. It is entitled “A holistic approach to creating smart societies”.

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A holistic approach to creating Smart Societies

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1 Smart Cities and Society concept

1.1 Concept of smartness

The concept of ‘Smart’ in the 21st century is a phenomenon associated with advances in information and communication technologies (ICTs). The terminologies of ‘Smart Cities’ and ‘Smart Society’ are intertwined, with Smart Society having been inspired by the idea of the Smart City, which is a multifaceted concept that recognizes how cities when made ‘Smart’ will be more productive, more sustainable, and more pleasant places to live. One aspect of smart cities concerns augmenting service infrastructures (such as transport, energy, health, security and so on) with sensor-based digital technologies able to visualize patterns of service delivery, and use stretching across space and time and with a high degree of fidelity.

A ‘Smart’ environment puts people at the heart of advanced and instant solutions to the growing challenges presented by an increasing world population: transport, infrastructure and health service demands alongside environmental concerns for our food, water and energy supply. This allows researchers and policy makers to look at the societal problems and maximize the use of innovative technologies and collaboration across multiple sectors for people to create:

- Efficient and adaptable services;
- Connected and efficient cities and communities;
- Informed, engaged and contented citizens; and,
- Smart solutions and smart processes for service delivery.

Utilization of advanced technology revolutionizes the way citizens, cities, communities and services work together to create a truly smart society¹. Technologies, as a system, shape every part of our society, and even the human beings themselves. Societies where machines and humans work ever closely together

¹ _____ Japan in its five-year plan “Society 5.0” (2016-2020) observes that perennial problems of inequality, in-cohesion and estrangement will be left behind with the help of emerging technologies.

have opened new possibilities leading to not only changes in the operations of the entire scientific communities, but also improvement in people's lives world over.

Thus, the creation of smart cities and society is dependent on harnessing the power of computers and human brains alike to open a new world of possibilities in solution creation and service delivery. 'Smart Society' extends the 'Smart City' thinking in a number of ways, for example, by including the ideas of:

- Hybrid computing: how people and machines working together create new sorts of problem solving capability, for example, as in the "wisdom of the crowds" — but also stemming from people's everyday use of their mobile connection to data, algorithms and social networks to solve problems;
- Adaptivity: bringing to the appropriate sub-collective to bear to solve a given problem; and,
- Learning: accreting knowledge of how the system responds to different circumstances and using that to drive subsequent rounds of adaptation.

1.2 Definitions of Smart Cities and Society

Online literature search reveals that the term 'Smart Society' was first coined by an EU-funded Integrating Project (IP)² that aimed *"to capture how contemporary technological trends can be harnessed towards solving challenges facing modern society. The 'Smart' alludes to the enabling capabilities of innovative, social, mobile and sensor based technologies that in various way are envisaged to create more productive alignments between (growing) demand and (constrained) resources across a number of sectors and application domains."*³

In recognition of the need to have a concrete definition for smart sustainable cities which can be used worldwide, ITU-T set up a Focus Group on Smart Sustainable Cities (FG-SSC)⁴. The Focus Group studied and analyzed approximately 116 existing definitions of smart sustainable cities and settled for: *"A smart sustainable city is an innovative city that uses information and communication technologies (ICTs) 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 and environmental aspects."*⁵

The definition was arrived to after identifying the core themes for SSC as: (1) society, (2) economy, (3) environment, and (4) governance and using the following key attributes of a SSC: (1) sustainability, (2) quality of life, (3) urban aspects, and (4) intelligence or smartness as a guideline.

However, the definition from ITU-T FG-SSC overlooks the human element of engaging and collaborating in a society and going beyond technology. The Final Report of ITU-D Study Group 2 Question 1/2 for the study period 2014-17 observed that the description of a smart society requires one to make it clear what is the nature of smartness in terms of 'governance', 'citizens' and 'way of life' and concluded that *"[a] smart society is one that leverages on the power and the potential of technology to make human beings more productive; to allow us to focus our resources on activities and relationships that matter; and ultimately to improve health, wellbeing and the quality of life."*⁶

The creation of a smart society is underpinned in the following pillars: (a) Smart life - intelligent social construction; (b) Holistic intelligent infrastructure; and (c) Intelligent governance.

² _____ Smart Society (FP7/2007–2013) Grant agreement n. 600854, <http://www.smart-society-project.eu/>.

³ _____ M. Hartswood et al., "Towards the Ethical Governance of Smart Society", Social Collective Intelligence - Combining the Powers of Humans and Machines to Build a Smarter Society, pp. 3-30, Springer, 2014, <http://www.smart-society-project.eu/wp-content/uploads/pdfs/papers/Hartswood14.pdf>.

⁴ _____ See ITU-T Focus Group on Smart Sustainable Cities: <https://www.itu.int/en/ITU-T/focusgroups/ssc/Pages/default.aspx>.

⁵ _____ See https://www.itu.int/en/ITU-T/focusgroups/ssc/Documents/Approved_Deliverables/TR-Definitions.docx.

⁶ _____ See the Final Report ITU-D SG2 Question 1/2 for the study period 2014-2017, <https://www.itu.int/pub/D-STG-SG02.01.1-2017>.

The super-smart society ‘Society 5.0’ goes beyond the fourth industrial revolution (e.g. Internet of Things (IoT), big data, artificial intelligence (AI), robot, and the sharing economy) into every industry and social life. Thus, the society of the future will be one in which new values and services are created continuously, making people’s lives more conformable and sustainable.

A paper describes a smart society as: *“One that successfully harnesses the potential of digital technology and connected devices and the use of digital networks to improve people’s lives.”*⁷ While another paper defines a smart society as: *“A society where digital technology, thoughtfully deployed by governments, can improve on three broad outcomes: the well-being of citizens, the strength of the economy, and the effectiveness of institutions.”*⁸

Society is progressively moving towards a socio-technical ecosystem in which the physical and virtual dimensions of life are more and more intertwined and where people interaction, more often than not, takes place with or is mediated by machines. More broadly defined, the future smart society is one that is moving towards hybrid systems where people and machines tightly work together in synergy and complement each other and operate collectively to achieve their day-to-day activities.

Thus a ‘Smart Society’ can be described as *“One that successfully harnesses the potential of digital technology and connected devices and the use of digital networks to improve people’s lives.”*⁹

1.3 ITU Member State contributions on the concept of Smart Cities and Society

In their efforts to share experiences and lessons learnt in the process of creating Smart Cities and Society, delegates from ITU Member States and Sector Members have submitted and presented contributions on this topic. A contribution from China (People’s Republic of)¹⁰ recognizes that the starting point and goal of intelligent social construction is to meet the needs of the people including medical treatment, education, social security, transportation, employment and pension services. Information resources and information technology help the implementation of service equalization and homogenization and promote the degree of satisfaction and happiness for people living in the social.

In addition, creating a smart society calls for top-level design considering all aspects of the architecture, all kinds of power and all kinds of positive factors and the limitation of the negative factors as a whole. The infrastructure is the basis of the smart society and includes both information infrastructure such as networks, cloud computing data center, big data platform and intelligent-upgraded municipal infrastructure including power, water and transport network.

In a narrow sense, ‘Smart Society’ can be aligned with smart government and smart economy, but refers more to smart applications in social governance and service areas. The components of a smart society can include such key elements as smart social facilities, smart social governance, smart social services and smart social ecology. The supporting areas include industries and fields closely related to social operations and services such as smart communities, smart urban management, intelligent comprehensive management, smart transportation, smart medical care, smart education and smart social security.

In a broad sense, ‘Smart Society’ is an advanced social form in the information age which contains the characteristics of data-driven, intelligent social support, shared governance, honesty and transparency, which adopts inclusive innovative development thinking. Which further makes use of a new generation of information

7 _____ C. Levy and D. Wong, “Towards a smart society”, Big Innovation Centre, June 2014, http://www.biginnovationcentre.com/media/uploads/pdf/1425646824_0714590001425646824.pdf.

8 _____ B. Chakravorti and R.S. Chaturvedi, “The ‘Smart Society’ of the future doesn’t look like science fiction”, October 2017, <https://hbr.org/2017/10/the-smart-society-of-the-future-doesnt-look-like-science-fiction>.

9 _____ C. Levy and D. Wong, “Towards a smart society”, Big Innovation Centre, June 2014, http://www.biginnovationcentre.com/media/uploads/pdf/1425646824_0714590001425646824.pdf.

10 _____ Document 2/81 from China (People’s Republic of)

technology, bridges the gap between social groups and interregional development imbalances.

In the Republic of Korea, the National Information society Agency (NIA) released ‘The Future of Smart Society and Smart South Korea’ in September 2012, which mentioned ‘Smart Society’. The report pointed out that following the agricultural society, industrial society, and information society, the development of smart technologies has brought social changes and humanity into a smart society. The content of the ‘Smart Korea’ strategy is to realize an advanced smart society.

Japan aims at an ‘ultra-smart society’. On 22 January 2016, the Japanese Cabinet of Ministers reviewed and approved the ‘Phase 5 Science and Technology Basic Plan (2016-2020)’ and put forward the vision of social development for the ‘super-smart society’. In May 2016, the Ministry of Culture, Science and Technology of Japan issued the “Science and Technology White Paper”, which further describes the connotation and characteristics of the future ‘super-smart society’. The ‘super-smart society’ would make use of information and communication technologies (ICTs), based on the Internet or the Internet of Things (IoT), highly integrate cyberspace and the physical world, provide necessary things to the necessary people in necessary time, and effectively respond to the needs of various segments of society.

A contribution from the Republic of Korea¹¹ reveals that the concept of smart societies and cities presents a paradigm shift in terms of strategic planning and implementation. At the core of the strategies lies the switch from previous technology-oriented approaches to people-oriented ones. Rather than aiming to develop cities from technological and physical perspectives, the set of new smart city strategies aims to improve convenience and happiness of the people living in the cities.

There have been limitations to enhance public satisfaction as smart cities have so far been implemented based on supply-driven approaches that mainly reflected the perspectives of city developers. To complement such existing approaches, new smart city policies define a smart city as a platform which will undergo ongoing innovations rather than a one-time product and aim to create citizen-oriented and people-oriented smart cities.

2 Key principles of the holistic approach

A contribution from India¹² emphasizes that the adoption of emerging technologies, including Cloud, the Internet of Things (IoT) and Big Data, would be leveraged to build state-of-the-art architecture. Open source and open standards-based technologies would be adopted to ensure that various e-governance systems can be integrated and made interoperable.

The Government of India has started ‘Digital India’ programme to transform India into a digitally empowered society and knowledge economy. The vision of the programme is concentrating on three areas: (1) Digital infrastructure as a utility to every citizen, (2) Governance and services on demand and (3) Digital empowerment of citizens. The country will encounter such old problems as ‘fragmented’, ‘information island’ and so on, without a holistic design guidance and a unified technical standard.

2.1 Top-bottom/bottom-up design

The top design is aimed at promoting wisdom society construction considering all aspects of the architecture, all kinds of power and all kinds of positive factors and the limitation of the negative factors as a whole. A top-bottom (or top-down) approach is centrally controlled and refers to a process that is led and orchestrated by upper level authorities or organizations which then diffuse their views and decisions to the lower-level actors. Namely, this approach presents a central planning and does not take into account the plurality of all involved stakeholders.

In contrast, a bottom-up or (down-top) approach is based on lower-level initiatives represented by the community (grassroots) voice and/or local

¹¹ _____ Document [SG2RGQ2/67](#) from Korea (Rep. of)

¹² _____ Document [2/72\(Rev.1\)](#) from India

authorities/organizations that can then raise their demands and thoughts to higher hierarchical levels to be considered in the strategic planning.

In the case of smart cities planning, the two concepts may exist individually or in a hybrid fashion. The choice depends on many factors involving the maturity of the community, the availability of effective up-forwarding channels, the time to implement, the political mandate, scale of implementation, etc.

2.2 Enabling infrastructure

Infrastructure is the basis of a smart society and includes both information infrastructure such as networks, cloud computing data center, big data platform and intelligent-upgraded municipal infrastructure including power, water and transport network. The information infrastructure is evolving toward “high-speed broadband, ubiquitous mobility, intelligence, and integration”. Urban planning should strengthen the intensive construction of various types of information infrastructure, coordinate the construction of urban optical fiber, base stations and pipelines, and promote the integration and utilization of regional data center resources.

2.3 Sharing

A key characteristic and building principal is sharing a unified national information platform to share resources across machines, people, departments, and cities efficiently utilizing available resources. Sharing includes both physical and logical resources and assets in order to assure both cost savings and data integrity. Sharing also implies ownership sharing. Namely, partnership among different stakeholders is an important factor for framing sustainable policies towards long term welfare of the community, overcoming all obstacles, thus stepping towards a smart society.

2.4 Innovation

Smart cities and society are marked by the migration from a supply-based society to an evolving and varying demand-based society. This then calls for the adoption of innovative development environments to accommodate new technological trends and inspire public and private sector growth.

2.5 Intelligent governance

Intelligent governance refers to the using of information technology such as big data, cloud computing, Internet of Things (IoT), and so on, in city management, ecological environment, public safety, and emergency accident processing areas for accurate analysis, monitoring and feedback. Information technology not only provides tools for managing the public affairs of state and society effectively, but also bring about changes in the mode of social governance from government control to collaborative governance.

2.6 Smart life style

The starting point and goal of intelligent social construction is to meet the needs of the people, including medical treatment, education, social security, transportation, employment, and pension services. Information resources and information technology help the implementation of service equalization and homogenization and promote the degree of satisfaction and happiness for people living in the society.

2.7 Standardization

Unified standard is the premise of information system interconnection and inter-operation. Standardization is an important and fundamental work to promote the practice of intelligent social construction. The engineering construction and software product research and development can only be guaranteed through the unified technical requirements and project requirements.

The Republic of Korea is considering to build standardization governance where all relevant ministries and private companies will participate and actively support global standardization activities¹³.

13 _____ Document [SG2RGQ2/67](#) from Korea (Rep. of)

2.8 Community participation

Community participation includes two aspects:

- Involvement in decisions: Citizens' participation in policy making and implementation of government decisions can lead towards a smart society and to achieving the sustainable development goals (SDGs). For achievement of the SDGs, it is necessary that smart cities or villages implement smart ways for their development. So the rights, demands, needs of people are to be understood first. It is also important to induce the sense of sharing the ownership by individuals for each development project.
- Skills and cultural development: ICTs alone cannot bring any change to human life until these technologies are coupled with attitudinal and cultural change, along with skills development, to be able not only to deal with and match the smart environment but also to maintain and further develop it.

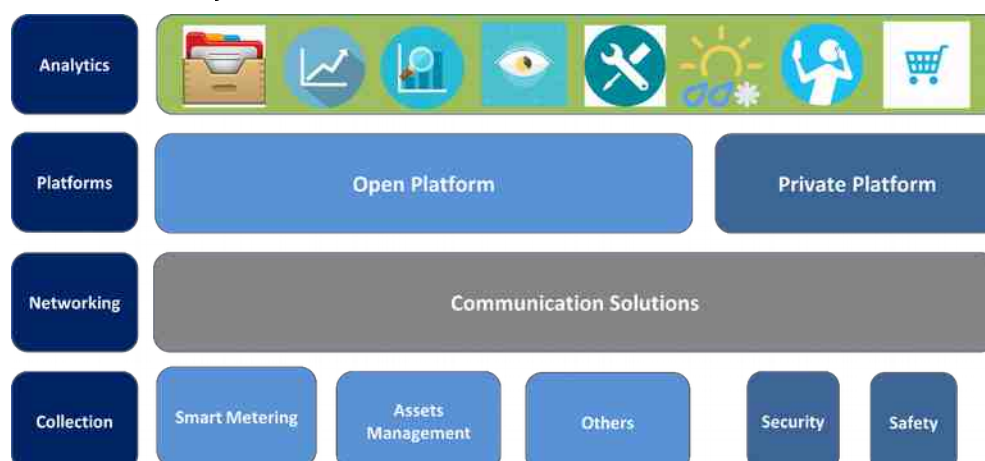
2.9 Effective business models (sustainability)

Smart cities and society are built to sustain and as such effective business models are sought. Many stakeholders are involved in the development of a smart city, including, the state or municipality, real-estate developers, infrastructure/network owners, utility and service providers, and application developers. Interactions and business relationships among those stakeholders have to be carefully developed to assure flexibility, adaptability and sustainability.

3 Layered architecture of a Smart City and Society

Based on the core design concepts presented above, the architecture of a smart city can be considered using the following layered model¹⁴ (see **Figure 1**):

Figure 1: Information layered architecture in smart cities



3.1 Collection

ICTs allows city officials to interact directly with the community and the city infrastructure and to monitor what is happening in the city, how the city is evolving, and how to enable a better quality of life. Through the use of sensors integrated with real-time monitoring systems, data are collected from citizens and devices – then processed and analyzed. At the data collection layer, two different classes of information are considered: security information (such as those collected from CCTV cameras) and smart information (related to smart services).

3.2 Networking

The collected information from different sensors is then carried out via a communications medium to centralized units for processing. Networking involves both access and core networks. A core network is used to connect different switching or data centers in the city (based on the city size). There are different alternatives for access networks based on the information class, data size and service/application type. Access networks could encompass wired or wireless solutions and proprietary or open standards. It involves two types of access sub-networks: security sub-network (conveying security information class) and smart sub-network (conveying smart information class).

3.3 Platforms

Collected data from various sources need to be integrated and stored using data management platforms that represent an intermediate layer between raw unstructured data and the higher level of data analytics. As shown in **Figure 1**, there may be two types of platforms, named as ‘open’ and ‘private’. The open platform could be in charge of managing the smart information class while the private one is in charge of managing the security information class. Another alternative is to have one platform managing both classes of information. Either choice depends on the level of security and conservation each city may have.

3.4 Analytics

Different techniques of data analytics are finally applied to the integrated and managed data for monitoring purposes, drawing specific insights, or controlling the real world and taking proper decisions to manage different resources and ensure city safety. Namely, the information and knowledge gathered are keys to tackling inefficiency with the aid of data analytics.

4 Case studies

4.1 Differentiated approaches to cities at different development stages – Republic of Korea

The first pillar of Republic of Korea’s new smart city strategies is to apply different approaches to different cities depending on their types. Until now, Korea’s smart city

policies have tended to employ similar strategies regardless of whether the city is new, old, big or small to medium-sized. However, the new smart city strategies categorize the types of cities as newly developed, mature and deteriorated, and pursue the most optimal policies for respective cities that best fit their development stage.¹⁵

Table 1: Smart city approaches to different types of cities

Type	Direction	Key policy
Newly developed city	Apply new technologies and establish new infrastructures	National pilot cities and regulatory sandbox
Mature city	Develop services promptly by using mature technologies	Build a data hub, create specialized themed complexes
Deteriorated city	Apply smart solutions under the government's leadership	Regenerate a city based on smart city strategies

4.2 Practical cases for building Smart Society – People's Republic of China

Case studies from China (People's Republic of) to build a smart society were related in the following areas.¹⁶

Smart application system

It is a key component in the construction of smart parks having a direct bearing on the consolidating critical information to the core system for the operation of the park, it will be able to respond smartly to various needs related to the residents' life, environment, public safety and commercial activities, while ensuring the smart and smooth operation of the park.

Smart government

At present, many areas in China are actively exploring the reform and innovation of the administrative examination and approval management system. Among them, the one-stop approval service in Yinchuan and the blockchain government service in Nanjing have achieved remarkable achievements.

Smart governance

- 1) Grid management system in Guangzhou: The system incorporates community management, services, and autonomy into the grid, and establishes a basic information database centered on people, places, objects and events.
- 2) "Web Weaving Grid management Project" in Shenzhen: Shenzhen has established a unified public information database, which contains 3.8 billion business data from 10 districts and 23 government departments, and achieved data sharing between departments and data exchange between districts, streets, and communities.

Smart services

- 1) Smart applications based on Narrowband IoT (NB-IoT): Yingtian has carried out various IoT applications based on NB-IoT technology, such as smart parking, smart lighting, and smart water meters.
- 2) Smart services based on big data and AI: Beijing and Baidu have jointly launched the Beijing Health Cloud platform to collect people's health data through wearable devices and sensors..

4.3 Use case for 'Digital India' – India

¹⁵ _____ Document [SG2RGQ2/67](#) from Korea (Rep. of)

¹⁶ _____ Documents [2/55](#) and [2/81](#) from China (People's Republic of)

The Government of India started the ‘Digital India’¹⁷ program to transform India into a digitally empowered society and knowledge economy. The vision of the program is concentrating on three areas:

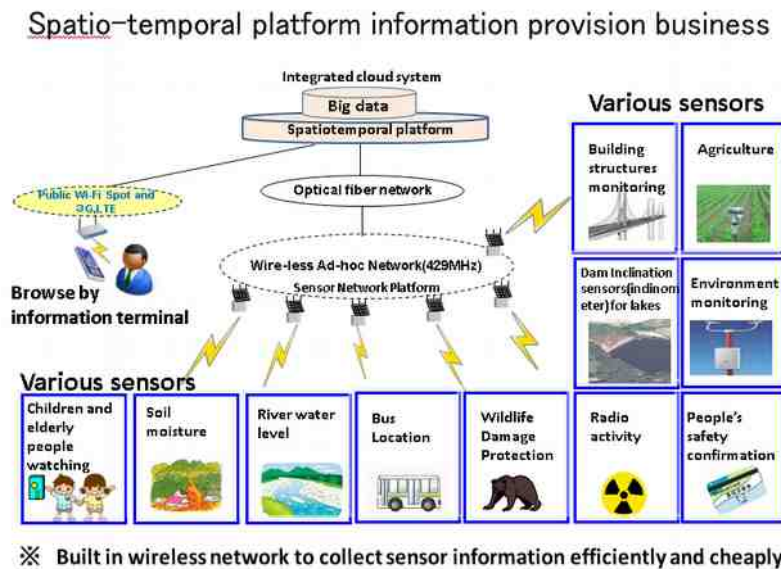
- 1) Digital infrastructure as a utility to every citizen,
- 2) Governance and services on demand and
- 3) Digital empowerment of citizens.

It aims to provide a thrust to the nine pillars of growth areas e.g. broadband highways, universal access to mobile connectivity, public internet access, e-governance, electronic delivery of services, information for all, electronic manufacturing, IT for jobs, and early harvest programs.

4.4 Use case for IoT sensor networks in Japanese local communities – Japan

In recent activities for ICT development, Shiojiri city invested for the building network of various IoT sensors in every corner of the region to automatically collect the environmental data and exchange the obtained data among concerned organization for the benefits of the community dwellers (see **Figure 2**).¹⁸

Figure 2: Shiojiri’s environmental information data collection platform and its IoT sensor network



The unique data collected could be analyzed in combination with other data in consideration of time and location for new valuable information which will be of importance for development of regional economy.

17 _____ Document [2/72\(Rev.1\)](#) from India

18 _____ Document [SG2RGQ/28](#) from Japan