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Study Group 2 Question 1

Creating smart cities and society: Employing information and communication technologies for sustainable social and economic development

Output Report on ITU-D Question 1/2

Creating smart cities and society: Employing information and communication technologies for sustainable social and economic development

Study period 2018-2021

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This report was prepared in response to Question 1/2: **Creating smart cities and society: Employing information and communication technologies for sustainable social and economic development** under the overall guidance and coordination of the management team of ITU-D Study Group 2 led by Mr Ahmad Reza Sharafat (Islamic Republic of Iran), as Chairman, supported by the following Vice-Chairmen: Mr Nasser Al Marzouqi (United Arab Emirates)(resigned in 2018); Mr Abdelaziz Alzarooni (United Arab Emirates); Mr Filipe Miguel Antunes Batista (Portugal)(resigned in 2019); Ms Nora Abdalla Hassan Basher (Sudan); Ms Maria Bolshakova (Russian Federation); Ms Celina Delgado Castellón (Nicaragua); Mr Yakov Gass (Russian Federation)(resigned in 2020); Mr Ananda Raj Khanal (Republic of Nepal); Mr Roland Yaw Kudozia (Ghana); Mr Tolibjon Oltinovich Mirzakulov (Uzbekistan); Ms Alina Modan (Romania); Mr Henry Chukwudumeme Nkemadu (Nigeria); Ms Ke Wang (China); and Mr Dominique Würges (France).

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Executive summary

In recognition of the important role played by information and communication technologies (ICTs) in society today, the 2017 World Telecommunication Development Conference (WTDC-17) approved the continuation of Question 1/2 ("Creating smart cities and society: Employing information and communication technologies for sustainable social and economic development").

Pursuant to the WTDC-17 resolutions and guidelines, this report documents the experiences and contributions shared by Member States and partners on the creation of smart cities and society. The concept of smartness in the 21st century is associated with advances in ICTs, and encompasses implementations at different scales: a city, a village, a region, or an entire society. From another perspective, it impacts all levels and stakeholders starting from individuals and ending with governments.

The report starts, in Chapter 1, with a description of the concept of a smart city and society, identifying common fundamental components of the smartness concept.

Chapter 2 describes the foundation-layered architecture of a smart city and presents the most important design principles to be considered when planning for a smart city. It also highlights basic design considerations for a reliable and strong core telecommunication infrastructure.

With the concept and the design principles established, Chapter 3 presents the enabling environment for creating a smart city and society from both the business and the policy perspectives. Chapter 4 follows with a set of vertical applications that can be considered for implementation in a smart city. Safety and trust issues are also introduced in this chapter, as a component integral to smart applications. Finally, Chapter 5 presents the key performance indicators that smart cities and communities can use to assess the level of smartness and the smartness gap.

This report is the culmination of three years of work, with a high level of interest and a number of contributions from the membership. It follows the three annual progress reports already delivered.

Future of the Question

Based on the outcomes of work on the Question so far and the need to continue developing smart cities, communities and the whole of society, it is proposed to continue work on the Question in the next study period.

Chapter 1 – Introduction

In this era of the fourth industrial revolution, all facets of livelihood in society – culture, education, health, transport, trade and tourism – will depend for their development on the advances made through information and communication technology (ICT) systems and services. The United Nations 2030 Agenda for Sustainable Development recognizes the enormous possibilities offered by ICTs and calls for a significant increase in access to such technologies, which have a decisive contribution to make in support of the implementation of all the Sustainable Development Goals (SDGs).

ICTs will continue to play a key role in protecting property and persons, implementing smart management of motor vehicle traffic, saving electrical energy, measuring the effects of environmental pollution, improving agricultural yield, increasing efficiency in global travel and tourism, managing healthcare and education, managing and controlling drinking water supplies and solving the problems that cities and rural areas are facing. Pursuant to the resolutions and guidelines of the 2017 World Telecommunication Development Conference, this output report on ITU Telecommunication Development Sector (ITU-D) Question 1/2 for the study period 2018-2021 documents the experiences and contributions shared by Member States and partners concerning the creation of smart cities and smart society. Delivering on the promise of smart society relies on three technological pillars – connectivity, smart devices and software – and on respecting the principles of sustainable development.

Today, more than half of the world's population lives in urban areas. According to the United Nations, by 2050 two-thirds of the world's population will reside in densely packed megacities, making it urgent to alleviate the pressures and the impact of overcrowding. In other words, by 2050, some 2.5 billion additional people will join those already living in cities around the world. These additional populations threaten to overwhelm existing city infrastructures. As the global population continues to grow, cities will need to adapt to support the unique needs of their citizens. Understanding the probable key trends in urbanization over the coming years is crucial to the implementation of the 2030 Agenda for Sustainable Development, in particular SDG 11: Make cities and human settlements inclusive, safe, resilient and sustainable.

1.1 Objectives of the Question

The key objectives of Question 1/2 on smart cities and communities include:

a. Discussion of methods of improving connectivity to support the smart society, including connectivity to support smart grids, smart cities and ICT applications in public administration, transport, business, education and training, health, the environment, agriculture and science.
b. Examination of best practices for fostering and enabling deployment and use of smart devices, including mobile devices, and the importance of the application of such devices.
c. Sharing of experiences and best practices in building smart cities.

1.2 Expected outputs and outcomes

The key outputs include:

a. Guidelines on policy approaches to facilitate the development of ICT applications in society, fostering social and economic development and growth.
b. Case studies on the application of Internet of Things (IoT) and ICT applications in building sustainable cities and communities, identifying the trends and best practices implemented by Member States as well as the challenges faced, in order to support sustainable development and foster smart societies in developing countries.
c. Organization of workshops, courses and seminars for the development of capacities allowing improved uptake of ICT applications and IoT.
d. Annual progress reports, which should include case studies, and a detailed final report containing measurement analysis, information and best practices, as well as any practical experience acquired in the areas of use of telecommunications and other means of enabling ICT applications and connecting devices for development of the smart society.

1.3 Methodology

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 contributions and made presentations on this topic. In addition, a series of workshops has been conducted at which experts and Member States shared their experiences. Finally, activities and studies carried out by the ITU Telecommunication Development Bureau (BDT) in relation to the subject of smart cities and communities have been reflected when applicable.

1.4 Smart cities and society concept

1.4.1 Concept of smartness

The concept of smartness in the 21st century is associated with advances in ICTs along with their potential applications across different sectors and domains. The terminology of smart cities and smart society is intertwined, as the notion of smart society was inspired by the idea of the smart city, which is a multifaceted concept that recognizes that smart cities will be more productive, more sustainable, and more pleasant places to live in. 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 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: 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;
- 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 society.[1] Technologies, as a system, shape every part of our society, and even the human beings themselves. Societies where machines and humans work ever more closely together have opened up new possibilities, not only leading to changes in the operation of entire scientific communities, but also improving people's lives the world over.

Thus, the creation of smart cities and society is dependent on harnessing the power of computers and human brains alike to open up a new world of possibilities in creating solutions and delivering services. The smart society extends smart city thinking in a number of ways, for example by including ideas such as:

- *Hybrid computing*: How people and machines working together create new sorts of problem-solving capability (the "wisdom of the crowds" phenomenon) – but also how people's everyday use of their mobile access to data, algorithms and social networks can solve problems.
- *Adaptivity*: Bringing the appropriate sub-collective to bear on a particular problem.
- *Learning*: Building knowledge of how the system responds to different circumstances and using that to drive subsequent rounds of adaptation.

1.4.2 Definitions of smart cities and society

An online literature search reveals that the term "smart society" was first coined by an EU-funded integrating project[2] that aimed to "*capture how contemporary techno-social 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 for a concrete definition of smart sustainable city (SSC) which can be used worldwide, ITU-T set up a Focus Group on smart sustainable cities (FG-SSC).[4] The focus group found more than one hundred existing definitions of SSC, and after analysing them 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 at after identifying the following core themes for SSCs: (1) society, (2) economy, (3) environment, and (4) governance. It builds on the following key attributes of an SSC: (1) sustainability, (2) quality of life, (3) urban aspects, and (4) intelligence or smartness as a guideline.

However, that definition overlooks the human element of engaging and collaborating in a society, which goes beyond technology. The Final Report of ITU-D Study Group 2 Question 1/2 for the study period 2014-2017 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

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1 Japan in its five-year plan "Society 5.0" (2016-2020) observes that perennial problems of inequality, incohesion and estrangement will be left behind with the help of emerging technologies.
2 Smart Society project
3 Mark Hartswood et al. Towards the Ethical Governance of Smart Society, in *Social Collective Intelligence - Combining the Powers of Humans and Machines to Build a Smarter Society*. Springer, 2014.
4 ITU. ITU-T Focus Group on smart sustainable cities
5 ITU. ITU-T Focus Group on smart sustainable cities. Focus Group technical report. Smart sustainable cities: An analysis of definitions. October 2014.

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]

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, more often than not, people are interacting with machines, or at any rate via 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, complement each other and operate collectively to achieve their day-to-day activities. Such a society would successfully harness the potential of digital technology and connected devices and the use of digital networks to improve livelihoods. Thus, a smart society goes beyond the fourth industrial revolution (e.g. IoT, big data, artificial intelligence (AI), robotics and the sharing economy) and penetrates not just industry but also social life. The creation of such smart societies is built on the following pillars: (a) smart life – intelligent social construction; (b) holistic intelligent infrastructure; and (c) intelligent governance.[7] The infrastructure layout is the basis of the smart society and includes both information infrastructures, such as networks, cloud computing, data centres and big-data platforms, and intelligently upgraded municipal infrastructure, such as power, water and transport networks.

In a broad sense, the 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 makes use of a new generation of information technology; and which thereby bridges the gaps between social groups and overcomes interregional development imbalances.

[6] ITU. Final Report on ITU-D Study Group 2 Question 1/2 for the study period 2014-2017. Creating the smart society: Social and economic development through ICT applications. ITU, 2017.

[7] ITU. ITU-D study groups. Annual deliverable report on ITU-D Study Group 2 Question 1/2 for the study period 2018-2021. A holistic approach to creating smart societies. July, 2019.

Chapter 2 – Concept design of smart cities and communities

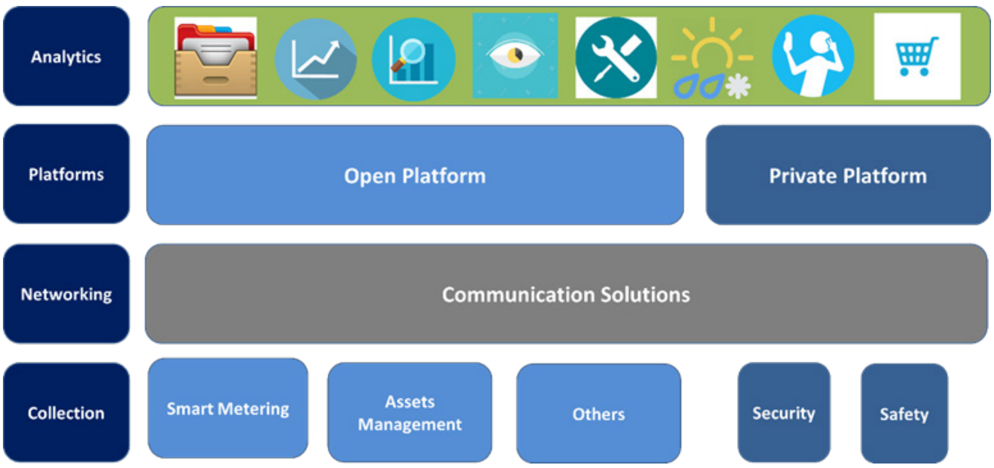
2.1 Fundamental architecture of a smart city

A contribution from India[8] shows how the adoption of emerging technologies, including cloud computing, IoT and big data, is being leveraged to build state-of-the-art architecture. Technologies based on open source and open standards are being adopted to ensure that various e-governance systems can be integrated and made interoperable.

The Government of India has started the Digital India programme to transform the country into a digitally empowered society and knowledge economy. The vision of the programme concentrates on three areas: (1) digital infrastructure as a utility for every citizen, (2) governance and services on demand, and (3) digital empowerment of citizens. Without holistic design guidance and a unified technical standard, the country will encounter such old problems as 'fragmentation', 'information island' and so on.

With this in mind, a contribution from Egypt[9] proposes a base for smart-city architecture using a layered model (see **Figure 1**).

Figure 1: Layered architecture in smart cities



2.1.1 Data collection

ICT 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 analysed. At the data-collection layer, two different classes of information are considered: security information (such as that collected from CCTV cameras) and smart information (related to smart services).

8 ITU-D SG2 Document 2/72(Rev.1) from India
9 ITU-D SG2 Document SG2RGQ/70 from Egypt

2.1.2 Networking

The information collected from different sensors is then carried 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 centres in the city (based on the city's size). There are different alternatives for access networks based on the information class, the volume of data and the type of service/application. Access networks can encompass wired or wireless solutions and proprietary or open standards. In addition, there are two types of access sub-network, which carry the above-mentioned classes of information: security information and smart information.

2.1.3 Platforms

Collected data from various sources need to be integrated and stored. This is done using data-management platforms, which represent an intermediate layer between raw unstructured data and the higher level of data analytics. As shown in **Figure 1**, there are two types of platforms, open and private, used to manage smart information and security information, respectively. Another alternative is to have one platform managing both classes of information. The choice depends on the city's needs in terms of type of management and level of security.

2.1.4 Analytics

This layer represents the high-level applications, in which the data collected are analysed for the purpose of monitoring, drawing specific insights, controlling the real world and assisting decision-making regarding resources and city safety. The information gathered and knowledge created are crucial inputs for tackling inefficiency with the aid of data analytics. When data sharing across different services is enabled via the common platform, inter-service data analytics is then ensured to assure effectiveness of interrelated operations.

2.2 Design concept considerations

2.2.1 Top-down versus bottom-up design

Top-down design is aimed at promoting construction of a wisdom society considering all aspects of the architecture, all kinds of power and all kinds of positive factors and limitation of the negative factors as a whole. A 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. This approach involves central planning and does not take into account the plurality of stakeholders involved.

In contrast, a bottom-up approach is based on lower-level initiatives represented by the community (grassroots) voice and/or local authorities and organizations that can then escalate their demands and thoughts to higher hierarchical levels for consideration in the strategic planning.

In the case of smart-city planning, it is possible to incorporate both concepts, in 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.

2.2.2 Enabling infrastructure

Infrastructure is the basis of a smart society and includes both information infrastructure, such as networks, cloud computing, data centres and big-data platforms, and intelligent upgraded municipal infrastructure, including power, water and transportation networks. The information infrastructure is evolving towards 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 fibre, base stations and pipelines, and promote the integration and utilization of regional data centre resources.

2.2.3 Sharing

A key characteristic and building principle is a unified national information platform that makes it possible to share resources across machines, people, departments and cities, utilizing available resources more efficiently. Sharing includes both physical and logical resources and assets, in order to ensure cost savings and data integrity. Sharing also implies ownership sharing. Partnership among different stakeholders is an important factor for framing sustainable policies towards long-term welfare of the community, overcoming obstacles and moving towards a smart society.

2.2.4 Innovation

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

2.2.5 Intelligent governance

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

2.2.6 Smart lifestyle

Both the starting point and the ultimate goal of intelligent social construction are the needs of the people, including medical treatment, education, social security, transportation, employment and pension services. Information resources and information technology contribute to the implementation of service equalization and homogenization and enhance satisfaction and happiness for people living in the society.

2.2.7 Standardization and interoperability

A unified standard is a prerequisite for the interconnection and interoperation of information systems. Standardization is an important and fundamental contribution to the practice of intelligent social construction. Engineering, construction and software product research and development can only be guaranteed through unified technical requirements and project requirements.

A key issue in building a smart city or community is ensuring interoperability among different types of hardware, solutions and software as well as standardized codes of implementation when available.

The Republic of Korea is considering building standardization governance where all relevant ministries and private companies will participate and actively support global standardization activities.[10]

2.2.8 Skills development

ICTs alone cannot bring any change to human life until these technologies are coupled with attitudinal and cultural change, along with skills development, making it possible not only to deal with and match the smart environment but also to maintain and further develop it. Therefore, the residents of cities and communities have to be aware of the smart environment they are experiencing and also qualified to interact with it: to feel it, enjoy it and further improve it. This can be achieved by different means, including:

- Education: The concept of smart cities and societies needs to be introduced early enough to students.
- Community programmes: These are needed to educate adults and technology-illiterate people.

2.2.9 Community participation

Community participation includes involvement in decision-making: citizens' participation in policy-making and the implementation of government decisions can lead towards a smart society and help meet the SDGs. For the SDGs, it is necessary that smart cities or villages implement smart ways for their development. So the rights, demands and needs of people have to be understood first. It is also important to cultivate among individuals a sense of shared ownership in each development project.

2.2.10 Effective business models (sustainability)

Smart cities and smart societies are designed to be sustainable, so effective business models are needed. 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 these stakeholders have to be carefully developed to ensure flexibility, adaptability and sustainability.

2.3 Infrastructure and connectivity

A fundamental aspect of design is building a strong and reliable infrastructure that supports the massive amount of data being exchanged both within and outside a smart city. Careful infrastructure planning is needed from the outset to ensure scalability and seamless absorption

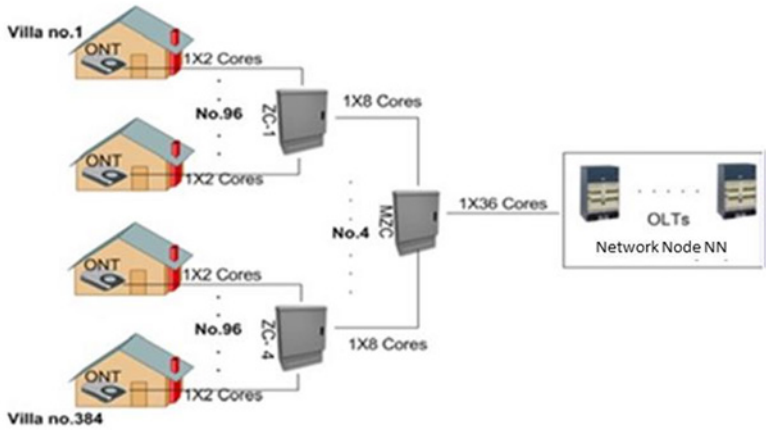
10 ITU-D SG2 Document SG2RGQ/67 from the Republic of Korea

of current and future services. To this end, a broadly available and reliable fibre-optic network is invaluable.

2.3.1 Optical distribution network

As explained in a contribution from Egypt,[11] an optical distribution network (ODN) comprises the passive physical network connecting an optical line terminal (OLT) located in the network node (NN) and an optical network terminal (ONT) located in the tenant area (residential or commercial), as shown in **Figure 2**.

Figure 2: Example of a fibre-to-the-home network based on gigabit-capable passive optical network topology



The physical configuration of an ODN is classified into two service categories as follows:

a) Telecommunication services

The main function of this category is to provide triple-play services through:

- primary cables from the network node to the main zone cabinet (MZC);
- secondary cables from the MZC to buildings or from the MZC to villas through zone cabinets (ZCs);
- passive optical splitters installed in ZCs or buildings as the middle points between the MZCs and the ONTs in the tenant areas.

b) Smart services

Smart services concern metering (electricity, water, etc.) and outdoor services (smart lighting poles, digital signage for bus stops, traffic control, etc.).

In this category, the network accommodates two separate passive optical networks (fibre-optic cables, splitters, etc.) sharing the same active source elements:

- metering and utility services;
- smart outdoor services.

[11] ITU-D SG2 Document SG2RGQ/193 from Egypt

The three services most commonly involved are thus telecommunications, utilities/metering and smart outdoor services. There are different options for design at the secondary network level. For example, it could consist of three different secondary networks, or it could combine utilities, metering and telecommunication services in one secondary network.

2.4 Best practices and case studies

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

The first pillar of the Republic of Korea's new smart-city strategy is to apply differentiated approaches to the various cities depending on their age and size. The new strategy categorizes the types of cities as newly developed, mature and deteriorated, and aims to pursue the policies that are optimal for each city's development stage, as shown in.**Table 1**[12]

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.

2.4.2 Practical cases for command and control centre and city operation centre – Egypt

A case study from Egypt[13] presented two main centres to be considered in the architecture of a smart city:

1) Command and control centre (CCC). The objective is to collect and process all critical and security-sensitive data to ensure a secure and safe city. It deals with security sensors and cameras and relies on a private platform for data management and processing along with related analytics.
2) City operation centre (COC). The main aspects of this centre include:
   - control of all non-critical data, including smart services/applications and basic ICT services;
   - possibility of using open data platforms;
   - interfacing directly with citizens and smart service providers;
   - responsibility for ensuring city sustainability.

[12] ITU-D SG2 Document SG2RGQ2/67 from the Republic of Korea
[13] ITU-D SG2 Document SG2RGQ/70 from Egypt

2.4.3 Practical cases for building a smart society – China

In building a smart society, case studies from China[14] have identified three key areas of focus: smart government, smart governance and smart services, as shown in **Table 2**.

Table 2: Areas and practical cases for building a smart society

Smart government	*Administrative examination and approval management system.* At present, many areas in China are looking at the possibilities for reform and innovation in this system. The one-stop approval service in Yinchuan and the blockchain government service in Nanjing have produced notable achievements.
Smart governance	*Grid management system in Guangzhou.* The system incorporates community management, services and autonomy into the grid, and establishes a basic information database centred on people, places, objects and events.
	"Web Weaving Grid management Project" in Shenzhen. Shenzhen has established a unified public information database with 3.8 billion business data records from 10 districts and 23 government departments, and provides for data sharing between departments and data exchange between districts, streets and communities.
Smart services	*Smart applications based on narrowband IoT (NB-IoT).* Yingtan has brought out various applications based on NB-IoT technology, such as smart parking, smart lighting and smart water meters.
	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.

2.4.4 Use case for "Digital India"

The Government of India started the Digital India programme[15] to transform India into a digitally empowered society and knowledge economy. The vision of the programme concentrates on three areas:

1) digital infrastructure as a utility for every citizen;
2) governance and services on demand;
3) digital empowerment of citizens.

The aim is to provide a thrust to the nine pillars of growth areas: 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 programmes.

[14] ITU-D SG2 Documents 2/55 and 2/81 from China
[15] ITU-D SG2 Document 2/72(Rev.1) from India

Chapter 3 – Business models and policy approaches

3.1 Business models

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 these stakeholders have to be carefully developed to ensure flexibility, adaptability and sustainability. The smart city will contribute to regional socio-economic development in the forestry, lumbering and related industries and the creation of job opportunities. This investment is expected to lead to marked improvements in quality of life in coming years.

Smart-city business models need to meet two requirements. One is to maximize cooperation and collaboration between the stakeholders, and the other is to achieve reasonable reductions in the cost of developing and maintaining the service. Meeting these two requirements will enable smart cities to sustainably provide useful services to citizens.

3.1.1 Collaboration of different stakeholders

3.1.1.1 Whole-of-government approach

A whole-of-government approach is a holistic, integrated method of planning, designing and delivering government services and operations. It requires that the government coordinate ministries and government organizational structures working together on policy development, citizen engagement and service delivery. This approach is cost-efficient, particularly with collective infrastructure or investment, and involves all government departments, projects and initiatives.

A whole-of-government approach is not limited to the national ministerial level; it is also used at the municipality and village level, where local government authorities collaborate on joint activities. However, adopting a whole-of-government approach demands that governments consciously challenge deeply entrenched silo and territorial behaviour.

3.1.1.2 Collaboration between government ministries

In the Republic of Korea, cooperation between related organizations is regarded as most important in developing smart-city services. This is because simply connecting existing public services with each other can spur the creation of new services and the improvement of existing ones. For example, CCTV information is shared between police, fire stations and other emergency-related organizations by means of a smart-city integrated platform. In general, government smart-city projects enjoy higher priority when more organizations participate and cooperate with each other.

Egypt[16] is developing smart street poles to provide additional services related to security, traffic and transportation management, etc. which will have positive social and business impacts. In order to achieve these various objectives, the participation of government departments and agencies, such as the ministries responsible for the interior and for energy, ICT and the environment, along with real-estate developers and municipalities, is indispensable.

The Indian Government is committed to providing affordable, accessible and efficient health services to its citizens.[17] The National Health Portal serves as a single access point for authenticated health information for citizens, students, healthcare professionals and researchers. The Online Registration System for public hospitals has brought about a significant change in the patient registration and appointment system and, as a result, patients now do not need to wait at hospitals for appointments.

3.1.1.3 Collaboration between government and industries

The city of Shiojiri in the Prefecture of Nagano in Japan has promoted the development of ICT-related device and application software by small and medium-sized enterprises (SMEs) and academia (universities, colleges and technical high schools) in the region. Shiojiri has established an incubation plaza where SMEs and academia collaborate on ICT development. Among recent ICT development activities, Shiojiri municipality has invested in the construction of a network of IoT sensors throughout the region to automatically collect and share environmental data with organizations concerned for the benefit of residents.[18]

In Sri Lanka,[19] the rapid development of the ICT sector has included a burgeoning e-health sector. The introduction of e-Sri Lanka initiatives has created favourable conditions and provided organizational support for e-health events. Many institutes and individuals, both public and private, have designed and implemented activities in the e-health domain. E-health consists of three main areas: mobile health, telemedicine, and e-learning in health science.

3.1.1.4 Collaboration of international organizations

The adoption of digital health systems involves a large volume of digitized information. Unfortunately, in many cases access to the data is hampered by the design of existing systems, resulting in islands of isolated information that have yet to meet expectations in terms of generating efficiency gains and improving health outcomes.

To facilitate the building of such integrated digital health systems, ITU, in collaboration with the World Health Organization (WHO) and other stakeholders, has published the Digital Health Platform Handbook,[20] a guide for implementing a digital health platform that can serve as an underlying digital health information infrastructure: an "info-structure" for digital health systems.

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16 ITU-D SG2 Document SG2RGQ/195 + Annex from Egypt
17 ITU-D SG2 Document SG2RGQ/159 from India
18 ITU-D SG2 Document SG2RGQ/28 from Japan
19 ITU-D SG2 Document SG2RGQ/110 from Sri Lanka
20 ITU and WHO. Digital Health Platform Handbook: Building a Digital Information Infrastructure (Infostructure) for Health. Geneva, 2020.

3.1.2 Cost of smart services

Despite significant investment, ubiquitous scale has not yet made itself felt in software platforms or data use; neither have technology markets moved to meet the SDGs. A key reason for this is that digital investments, like development investments in general, are often siloed by sector, resulting in significant fragmentation and duplication of efforts, which makes it difficult for governments and technology providers to benefit from economies of scale and aggregate demand across sectors.

A whole-of-government approach to investing in digital infrastructure can deliver digital services at scale with a better return on investment. Evidence from countries as diverse as India and Estonia shows that a government-wide approach to investing in shared digital infrastructure can lead to more rapid scale-up of development services with strong protection for citizen rights at a fraction of the cost.

Recognizing that many low-income countries lack the technical roadmap, the economic justification and the human resources required to emulate the sophisticated enterprise architecture approach employed in India, ITU and the Digital Impact Alliance (DIAL) have developed the SDG Digital Investment Framework to assist governments in prioritizing and implementing an initial set of shared ICT services that directly support national development priorities and can form the foundation of an emerging national application architecture.[21] Experience gained through the implementation of these shared ICT services provides a political, programmatic and technical basis for gradually building the governance mechanisms, human capacity and infrastructure needed to support the transition towards a digital economy.

Pilot projects help governments and municipalities to develop cost-effective smart-city services. A pilot project is an opportunity to reduce reliance on trial and error and to develop a standard service model.

3.1.3 Funding for digital identity[22]

Sufficient, consistent and continuous funding provides the foundation for an effective digital identity initiative. Based on one governance model established for the digital identity framework, the allocation of dedicated and appropriate resources for its implementation, maintenance and revision should be defined and specified in terms of financials (i.e. dedicated budget), people and material, as well as the relationships and partnerships and continued political commitment and leadership required for successful execution.

Digital identity systems can require high investments and costs (especially for sizeable populations), both in terms of upfront set-up as well as ongoing operation and maintenance costs. The kind of pricing and cost-distribution models that are selected are vital to ensure a sustainable digital identity system. Governments can consider potential revenue flow by offering identity services to offset the costs of digital identity development and for inducing sustainability in the operations.

Public-private partnerships can provide an avenue to relieve the fiduciary burden and have been demonstrated to be successful in many countries around the world. A financial and economic

21 ITU-D SG2 Document SG2RGQ/57 + Annex from the BDT Focal Point for Question 1/2
22 ITU-D SG2 Document SG2RGQ/56 + Annex from the BDT Focal Point for Question 1/2

model, with detailed expected costs, and potential revenue streams, needs to be developed upfront and implemented accordingly.

In the context of a digital identity framework, it is possible to identify three different approaches in terms of how the system is financed.

- *Public sector pays*: In this case, the public sector fully bears the costs of the digital identity system. Estonia is the most prominent example of this specific approach.
- *Public sector and private sector pay*: In this case, both the public and private sectors bear the costs of the digital identity system. This is a well-established model and many examples can be found.
- *Private sector pays*: In this case, the private sector fully bears the costs of the digital identity system.

3.2 Policy approaches

There are different policy approaches for smart cities and societies. Contributions from Member States and partners reveal that an investment-friendly policy and regulatory framework is needed to support digital transformation, which permeates all industries and impacts markets in all sectors. In addition, a long-term policy view is needed to ensure predictability and regulatory certainty that promote business and investment models and to deliver connectivity for all use cases. Such initiatives are implemented through government institutions/agencies, such as the National Telecommunications and Information Administration in the Unites States;[23] a government ministry, as in the Republic of Korea;[24] or telecommunication regulatory authorities. The case reported by the Republic of Korea involved overhauling the legal and regulatory framework as the first step towards the establishment of smart cities. As urban infrastructures and services are created and operated based on legislation, introducing entirely new urban infrastructures and services is impossible without first changing the underlying legislation.

The experience of the Republic of Korea shows that smart cities are subject to many laws, not merely the specialized legislation. Whereas special laws have the effect of overhauling relevant regulations from a smart-city perspective, existing laws prescribe the construction and operation of smart-city components from the sector's point of view. Special laws cannot solve all problems related to smart cities. It is important to understand what other laws are relevant to smart cities and to manage them in a comprehensive and coordinated way.

The Russian Federation has been implementing a smart-city project in the context of its national digital economy and housing and urban environment projects since 2019.[25] The principal objective is digitalization of the urban environment through modern technological solutions and cross-cutting increases in the effectiveness of urban infrastructure.

Since 2013, the State Council of China has issued several opinions on promoting consumption and expanding domestic demand; guiding opinions on actively promoting "Internet plus" action; a notice on the issuing framework for action to promote big data and on further promoting new urbanization construction; and other important documents on the healthy and orderly development of smart cities and on higher development standards.[26] In March 2016, the outline of the 13th five-year plan for the national economy put forward the new requirements:

[23] ITU-D SG2 Document SG2RGQ/154 from the United States
[24] ITU-D SG2 Document SG2RGQ/192 from the Republic of Korea
[25] ITU-D SG2 Document 2/266 from the Russian Federation
[26] ITU-D SG2 Document 2/279 from China

"building smart cities as we strengthen modern information infrastructure and promote the development of big data and the Internet of Things". At present, nearly 400 cities in China are actively exploring ways to construct and operate smart cities. Remarkable results have been achieved in Shanghai, Beijing and Guangzhou, enabling people to benefit from the development and effectively contributing to addressing the major challenges in people's daily life.

The construction of smart cities at all levels in China has shifted from being technology-oriented and construction-focused to application-oriented and operation-focused. As the technical architecture and business sectors are relatively mature, the focus has been on coordination of the relationship between the government and the market and between construction and operation, which has given the direction for exploring the way to build smart cities in various regions at the present stage.[27]

3.2.1 Fostering investment and innovation

The drive towards a digital economy has gained considerable importance within the global economy, as digitization is a recognized driver of innovation and competitiveness.[28] Within the global village, this new ecosystem presents a unique opportunity for economic growth. As digital technologies become the cornerstone of daily activities, governments, businesses and individuals must adapt to this new reality. Going digital is no longer simply the way day-to-day activities are conducted, but the bedrock of economic growth. To achieve the promise of smart communities, it is clear that the two keys will be collaboration and innovation.[29]

Smart cities that offer innovative solutions based primarily on ICT are a global issue. Public authorities have become heavily involved in projects to develop smart cities. The success of these types of cities is conditioned on the commitment and participation of all stakeholders, including the citizen or the user, who will have to be at the heart of public strategies.[30]

In order to foster co-creation, an interaction system based on transparency, access to information and dialogue must be put in place. The concept of citizen participation raises three essential points: first, the involvement of ordinary people who have no source of formal power; second, a power recognized by these people who drive the whole of the group to think and act in their direction; finally, the decisions made must have an impact on the community.

The Republic of Korea has been actively developing smart-city platforms since it started the u-City projects in 2003. The government has developed an approach based on the smart city as a platform. Busan National Pilot Smart City is developing three platforms for the future smart city.[31]

A platform-oriented approach has advantages such as lowering the cost of smart-city development, removing the obstacles between city domains and enabling bottom-up city innovation.[32]

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27 ITU-D SG2 Document 2/53 from the China International Telecommunication Construction Corporation (CITCC) (China)
28 ITU-D SG2 Document SG2RGQ/178 from Kenya
29 ITU-D SG2 Document SG2RGQ/154 from the United States
30 ITU-D SG2 Document SG2RGQ/172 from Algérie Télécom SPA (Algeria)
31 ITU-D SG2 Document 2/343 from the Republic of Korea
32 ITU-D SG2 Document 2/219 from the Republic of Korea

Encouragement and support on the part of governments and development partners for start-ups involved in the use of ICTs for socio-economic development and e-health will contribute effectively to attainment of the SDGs and promote the creation of smart cities and societies. To that end, strategies must be put in place that take start-ups into account and support them in their endeavours.[33]

Sèmè City is a showcase project of the Government of the Republic of Benin. Sèmè City is a unique place offering a conducive and attractive framework for several types of operator, including academia, research centres and incubators, a community of students, researchers, teachers, professionals and entrepreneurs, both Beninese and international. The promotion of entrepreneurs pursuing growth is a prime focus of Sèmè City's entrepreneurship programmes. Such entrepreneurs set themselves the objective of creating a successful business that reaches a critical size, offers opportunities for jobs and income for a large number of people, and presents a strong potential for innovation.[34]

New technologies such as 5G, IoT and AI will make cities smarter, providing the capacity not only to support this new wave of urban citizens, but also to significantly improve their liveability.[35] However, the challenges related to the adoption of IoT, especially in developing countries, are not only technical but also regulatory, societal, governmental and infrastructure-related. Cooperation among the different actors in standardization, as well as within the ecosystem itself, will be essential.[36]

3.2.1.1 Smart cities based on big data

Data resources have become a vital and basic resource for any country, and big data is regarded in most developed countries as an important factor in progress and development, with various policies being formulated and launched to promote it. With the development of IoT, big data is providing support and assistance to smart cities in various forms such as smart healthcare, smart transportation, smart living and smart homes. Urban governance has also evolved from experience-based governance to a more scientific approach, and the impact of the big data era on the development of smart cities is increasing.[37]

For achievement of the SDGs, it is necessary that smart cities and villages implement smart ways for development. The rights, demands and needs of people must be understood first. The vision of a smart society can be achieved by integrating ICT innovation as a key component of government policy, developing national e-strategies in coherence with public development goals, empowering citizens to innovate through new educational approaches, fostering the wider range of skills needed for innovation, and providing appropriate financing for ICT innovation.[38]

Building a smart-city brain can help emerging smart cities and societies overcome some persistent problems. First, faced with intricate urban operational management issues, current governance methods are inefficient. Second, cities are still unable to effectively utilize and capitalize on the vast amounts of data accumulated over the years, which results in a great waste

33 ITU-D SG2 Document SG2RGQ/24 from Benin
34 ITU-D SG2 Document 2/260 from Benin
35 ITU-D SG2 Document 2/211 from Intel Corporation (United States)
36 ITU-D SG2 Document 2/61(Rev.1) from the BDT Focal Point for Question 3/1
37 ITU-D SG2 Document 2/53 from CITCC (China)
38 ITU. Final Report on ITU-D Study Group 2 Question 1/2 for the study period 2014-2017. Creating the smart society: Social and economic development through ICT applications. ITU, 2017.

of public resources. Third, due to the proliferation of system and information islands, urban managers lack the decision-making support that a global overview and correlation analysis can provide; this makes it difficult for data to become the core driver of decision-making in most scenarios.[39]

3.2.1.2 Governance of digital identity[40]

For those countries that wish to pursue a national identification system, essentially three different models can be adopted for governing a national digital identity framework:

a. The government is directly involved as the identity provider.
b. The government only acts as regulator and is not involved as an identity provider.
c. The government acts as the regulator and identity broker/clearing house.

Governments need to constantly promote the digital identity initiative and its benefits to citizens, taking into account the different target audiences. They have to assess the context and decide on a communication strategy. This is an often-overlooked element that, when mismanaged, can gravely impair the success of the initiative.

3.2.2 Smart villages and communities

The smart village is a relatively new concept compared to the smart city, which seems to have been discussed at many forums in the past decade. Niger started reflecting on the establishment of smart villages in 2017. Smart village services including education, health and agriculture have been set up with support from the World Bank.[41]

The United States[42] has reported a special focus on smart communities, not just cities. In this case, the following factors, reinforcing and augmenting those set out in section 2.2, are important to consider:

- Take a bottom-up approach with community-level leaders facilitating initiatives and stakeholders engaged.
- Design around human needs.
- Enable the community to measure progress.
- Enable interoperability, replicability, scalability, extensibility and ability to update.
- Use pilot projects to drive innovation.
- Rural projects in particular need connectivity to benefit from smart technology and achieve economic growth.
- Privacy and cybersecurity should be built into project designs.

The United States has also expanded its vision beyond smart cities and rural communities to the concept of smart regions. This is the idea behind the new Smart Regions Collaborative under the Global City Teams Challenge (GCTC) initiative. Elevating conversations about smart cities and communities to the regional level achieved several goals: the benefits of scale, a wider net, and more holistic and sustainable projects.

[39] ITU-D SG2 Document 2/198 from China
[40] ITU-D SG2 Document SG2RGQ/56+Annex from the BDT Focal Point for Question 1/2
[41] ITU-D SG2 Document 2/280 from Niger
[42] ITU-D SG2 Document SG2RGQ/154 from the United States

Chapter 4 – Smart applications, safety and trust

4.1 Smart applications

Until now, smart cities have focused on finding solutions to urban problems and modernizing urban services. It is true that they have achieved excellent results in various fields such as transport, security and energy. However, service-oriented smart cities are struggling to develop various urban services as a kind of product. It is very difficult to add new technologies and innovations because the services are developed in their final form. To solve this problem, in the future smart cities need to focus on platforms.[43]

The main dimension of this evolution does not lie in the vertical optimization of different computer technologies, but in the horizontal penetration of these technologies and their integration in all sectors to move from a product technology to a service technology.[44]

4.1.1 The city as a development platform

The most basic issue regarding smart cities is defining the concept. Whereas many definitions have been provided, there are different versions of what a smart city is and how to build one. One open question is whether to regard smart cities as products or platforms. Products and platforms have completely different connotations. A product performs a complete and independent function, but once it is produced, it stops developing. In contrast, a platform does not perform a complete function by itself, but continues to evolve and innovate.[45]

Current methods of governance are ineffective against operational management problems in the context of an urban environment, with its legacy of data accumulated over the years and its numerous system and information islands. In order to solve these problems, some cities and companies around the world have taken the initiative by putting into practice the concept of an intelligent operating centre (IOC, also referred to as an "urban brain").

A smart-city brain needs to be guided by the government, driven by the market and combined with the actual development needs of the city, while being planned and deployed in a coordinated and orderly manner. Furthermore, in order to ensure the safety, stability and efficiency of the construction and operation of new smart cities, the city brain should be paired with a sound network structure and a sound system of standards for safety and controllability. A specialized agency managed by the government should be responsible for building and operating the city's brain and urban data resources. The urban data resource management system should be put on a firm statutory footing and recognized as a strategic resource. It is also important to specify clearly the requirements in terms of aggregation, sharing, exchange and open analysis of data resources.[46]

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43 ITU-D SG2 Document 2/343 from the Republic of Korea
44 ITU-D SG2 Documents 2/283 from CITCC (China) and 2/72(Rev.1) from India
45 ITU-D SG2 Document 2/343 from the Republic of Korea
46 ITU-D SG2 Document 2/198 from China

Platforms play a very important role in smart cities by providing the necessary common base for smart-city services. In their absence, it becomes difficult to link the services. Smart cities must be a space of convergence rather than being filled with islands of services. Platform-based services in a smart city can be easily linked and merged with each other, keeping development costs down by sharing infrastructure with associated services. Thus, as part of one smart-city project, a solutions bank[47] was created, bringing together projects distributed thematically and quantitatively in accordance with a previously established strategy.

The new national smart-city strategy approach is thus to promote the smart city as a platform. It should no longer be considered as a finished product like its urban components, such as buildings, cars and roads, but as a platform that continues to evolve by linking resources, data and different services.[48] **Table 3** lists the differences between a platform-based smart city and a service-focused smart city.

Table 3: Platform-based versus service-focused smart city[49]

Platform-based smart city	Service-focused smart city
– Sharing of service infrastructure – Convergence of related services – Lower development cost – Innovations by everyone – Bottom-up development	– Silos of service infrastructure – Separation of related services – Higher development cost – Innovations by big players – Top-down development

a) Sensor network

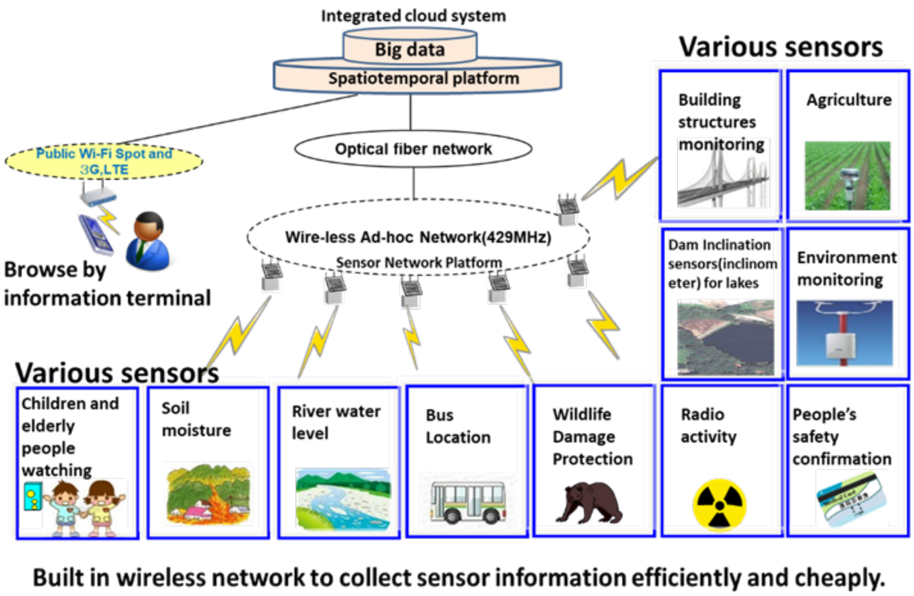
A sensor network can be easily deployed around a gigabit Ethernet fibre network and a wireless local area network with an ad-hoc configuration and the network interconnected with upper layer service providers. Distributed wireless repeater stations can be powered by solar panels and operate autonomously using low-cost IoT sensors that are efficiently interconnected. The IoT sensor network covers the region. The unique data, collected automatically, can be analysed in combination with other data in consideration of time and location for new valuable information which will be of importance for the development of the regional economy.[50]

Many smart city initiatives will start small, but grow fast, and scale big. The time is ripe for planning a massive take-up of sensor devices and applications, as well as an equivalent growth in data and network traffic. This requires a city ICT infrastructure that is scalable by design.[51]

A partial list of sensors may include: personal monitoring system for children and elderly people, soil moisture sensors, river water level sensors, wildlife damage protection sensors, radioactivity sensors, personal safety sensors, structural sensors for buildings, agricultural sensors, dam inclination sensors (inclinometer) for lakes, environment monitoring sensors.

[47] ITU-D SG2 Document 2/266 from the Russian Federation
[48] ITU-D SG2 Document 2/198 from China
[49] ITU-D SG2 Document 2/343 from the Republic of Korea
[50] ITU-D SG2 Document SG2RGQ/28+Annex from Japan
[51] ITU-D SG2 Document SG2RGQ/TD/2 from the Co-Rapporteurs for Question 1/2

Figure 3: Environmental information data-collection platform and its IoT sensor network

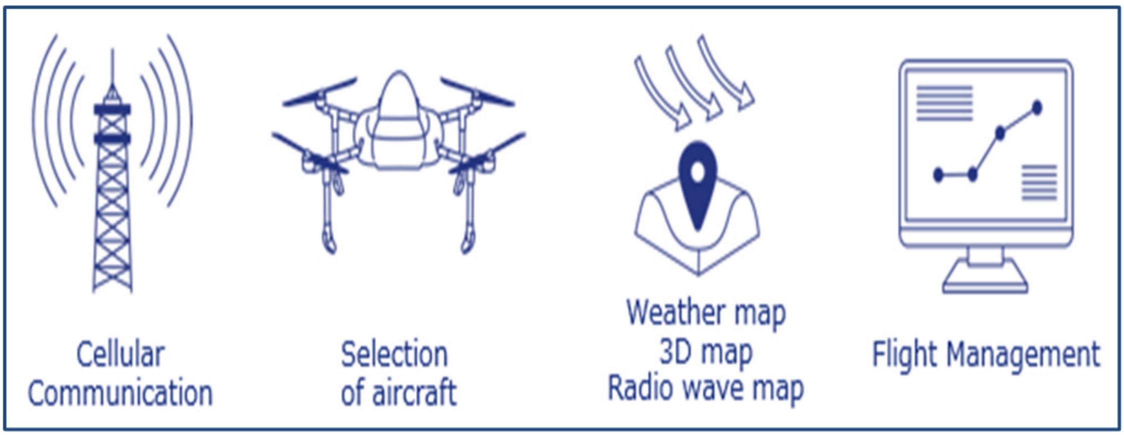


b) Drone platform

The usefulness of drones can be multiplied with the adoption of smart drone platforms that integrate a variety of features to allow remote monitoring and control of the drone via a dashboard. Supported functions could include live video, weather map, 3D map and radiowave map, with connection to cellular networks, the cloud and AI for data analysis.

Services that can benefit from the use of drones include inspection of roads, railways, power grids, telecommunication towers, disaster relief, public safety (e.g. by detecting suspicious behaviours at large-scale events in stadiums) and monitoring of plant health to allow early action on disease prevention.[52]

Figure 4: Smart drone platform



[52] ITU-D SG2 Documents SG2RGQ/176(Rev.1) from KDDI Corporation (Japan) and SG2RGQ/173 from Shinshu University (Japan)

Box 1: Use of drones in COVID-19 mitigation

The current pandemic has put the smart-city concept to the test. Achievements include optimizing mobilization of urban resources, improving the efficiency of city operations, using technology to promote precise social governance, and frontline organization of prevention and countermeasures in local communities.[1]

Drones have been used to perform a number of important functions, helping authorities and individuals act to prevent further spread of the coronavirus outbreak. Law-enforcement and municipal authorities have used them to monitor and enforce compliance with restrictions on movements and gatherings, for example.

They are also being used to broadcast messages and information about lockdown measures, especially in rural areas that lack open communication channels for health information. Drones equipped with loudspeakers are being used to make public announcements regarding the need to remain indoors, the necessary precautions such as social distancing and the importance of wearing a mask outside the home. Agricultural spray drones have been used to disinfect public spaces and potentially affected areas.

[1] ITU-D SG2 Document SG2RGQ/231(Rev.1) from China

This technology becomes particularly useful where it is important to limit physical contact and exposure of medical staff. Drones are being used to deliver groceries in red zones. Equipped with infrared cameras, they can be used to measure the temperature of people in lockdown.

The use of drones remains subject to strict national regulations, and their use for surveillance is the subject of an ongoing, society-wide debate about privacy and individual rights.

c) Augmented reality platform

Augmented reality (AR) is a service that reinforces users' cognitive ability by adding data information on top of real-world information. Already, car navigation services help drivers find their planned destinations. In order to utilize AR technology effectively, it is necessary to express reality space in cyberspace as it is, and to upload various data on it. In future, smart cities will be able to solve various difficulties in urban life by introducing AR technology in a number of fields. For example, foreigners visiting the city for the first time will no longer face the inconvenience of the language barrier.

d) Robot platform

The biggest change in future smart cities could well be the widespread use of robotics. At present, robot technology is not yet sufficiently advanced to allow use in actual urban environments, but this is expected to change soon. In particular, smart cities could play a key role in the advent of robotics because they complement robot technology. Building an urban infrastructure to enhance the functionality and stability of robots will allow the use of robotic technology in smart cities in the near future. Such a city incorporates urban infrastructure not only for humans, but also for robot utilization, and reserves a separate urban platform for robots.[53]

4.1.2 Smart utilities

Smart housing and utility (HU) systems aim to automate facilities to ensure timely utility meter readings, quality control of equipment, transparency for utilities, prevention of emergencies, etc.[54]

Generally, such systems are organized on three levels: the level of meters in apartments and houses, the meter-reading level and the level at which data processing and analysis take place.

The implementation of smart HU systems entails:

- smart utility resource accounting systems;
- digital modelling for infrastructure management;
- reductions in the energy consumption of state and municipal institutions;
- automatic systems for monitoring building condition: noise level, temperature, etc.;
- automated performance review for the response to consumer requests and incidents.

The mass production of smart metering devices for gas, water and electricity will allow electricity consumption to be managed via a mobile application. Smart devices will be able to receive and transmit information over the Internet, with cryptographic protection against unauthorized access and meter tampering. The data will be transmitted to the resource-supplying organizations, and uploaded to the end user's mobile application, allowing the customer to monitor all metering and pay for the utilities online.

A wireless system for remote HU meter readings will make it possible to:

- improve revenue collection;
- automate meter readings for water, electricity, heat and gas;
- provide end-to-end control of resource consumption at the level of an individual apartment or an entire building;
- bring down the cost of collecting and processing information and speed up the process.

Reliable and complete energy metering is the basis for reducing consumption and increasing efficiency, while also addressing revenue-collection issues. Smart grid-like distribution network operation will become a reality as the metering devices that are crucial control elements fur such networks become widespread.

Reducing energy consumption in residential and office buildings is a major economic and ecological objective, as it makes up a large part of society's overall energy consumption and is responsible for a large part of its production of carbon dioxide. New construction standards are required for intelligent buildings controlled by a highly adaptive system to avoid unnecessary energy expenditure, using photovoltaic sensors, solar water heaters, wind turbines, heat pumps with buried heat-exchange coils, improved insulation, air circulation and, in the case of a positive-energy building, surplus energy production.

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[53] ITU-D SG2 Document 2/343 from the Republic of Korea
[54] ITU-D SG2 Document SG2RGQ/TD/10 from the Russian Federation

Smart buildings will enhance convenience, well-being, information, safety and security of property and people, operations and maintenance. Sensors for building structures will monitor deterioration in public buildings, in particular ageing bridges and tunnels. These sensors will aid in decisions to prevent further deterioration, for example by detecting anomalous vibration characteristics. A dam tilt sensor system can provide early detection of the danger of dam collapse by fitting the tilt sensor inside and outside the dam dykes.[55]

Intelligent fire-prevention and related applications provide new methods and opportunities for risk prevention and control in urban residential areas, with functions such as intelligent equipment, intelligent warning and alarm and big-data applications.

Intelligent fire-prevention systems make possible intelligent interaction among three groups of users: community residents, property management and firefighters. Application of intelligent firefighting in risk prevention and control of urban residential areas involves operations such as monitoring and early warning by means of various sensors, monitoring of the water source for fire control, inspection of fire prevention facilities, combustible gas alarm control, automatic fire alarms, monitoring of fire access routes and key locations, and a smart energy system.[56]

4.1.3 Smart transportation

The global population is growing and becoming ever more urbanized. This urbanism is associated with ever more vehicles, and this is a contributing factor in the mounting problem of traffic accidents and traffic congestion. Every year the lives of more than 1.25 million people are cut short as a result of road traffic crashes. Traffic congestion causes loss of time and money, and it contributes to air pollution and global climate change. In the case of traffic accidents, victims' chances of survival rate are further affected because the arrival of emergency crews is delayed. One of the major challenges that growing cities face is therefore how to transport people and goods in a safe, secure and efficient manner.

In efforts to increase the efficiency of the transport system, the development of an intelligent transportation system (ITS) is relevant not only because of the steady growth of the number of cars on city roads or the problems of road congestion, but, even more, because of the need to guarantee the safety and convenience of the road network for all users through the introduction of innovative technologies and new management decisions.

ITS covers infrastructure, modes of transport, system users and road traffic regulations. ITS can comprise different models, technologies and systems. Commonly it involves systems for traffic-light network management, freight regulation, vehicle registration number recognition and even bridge-building and meteorological support systems. ITS can also involve the use of models which take account of the huge amounts of accumulated road traffic data.

An ITS uses information about the traffic load and condition of the road network along with hardware and software solutions to gather, process and store this information, keep it up to date, and make it available to stakeholders.[57] Open data is therefore a key driver for developing safe, trusted public transportation services. Real-time data, when made available to travellers, allows them to make better choices about their travel and priorities (e.g. safety, speed or cost).

55 ITU-D SG2 Document SG2RGQ/28+Annex from Japan
56 ITU-D SG2 Document 2/283 from CITCC (China)
57 ITU-D SG2 Document 2/266 from the Russian Federation

Building bus rapid transit (BRT) networks is one method countries use as part of a strategy to move towards smart transportation. BRT, with the help of advanced ICT technologies, improves the efficiency and effectiveness of bus services by providing seamless, fast, reliable, safe and convenient public transportation. The shorter lead-time for establishing a route (compared to metro or rail networks) means it can quickly transform transport routes and deliver positive results for issues such as congestion and pollution, with a quicker return on investment.[58]

Going beyond the final report on ITU-D Question 1/2 for the previous study period (2014-2017),[59] it has become increasingly important to optimize traffic control for efficient transportation by adding IoT sensors and AI technology to the surveillance camera systems of the existing ITS. The first step is traffic counting. It is possible to visualize the traffic situation by measuring traffic flow using information obtained by IoT sensors and surveillance cameras. Image analysis is the key technology here. The most important item of information is the number of people actually in transit, and not merely the number of vehicles. Thus, AI systems count the number of passengers in each vehicle.

The traffic-flow data obtained feeds into big data and AI processing which make it possible to proceed to the second step, determining the cause of congestion, and then the third, making predictions about traffic demand and congestion.

In the fourth step, traffic flow is dispersed on the basis of the predictions, leading to optimization of traffic control. Predictions are also used for long-term city planning. The number of vehicles alone is not sufficient for determining the substitution measures needed to dissolve congestion. A similar ICT system can be used for motorcycles and bicycles in town, and even pedestrians in shopping areas, stations, stadiums and tourist spots, making it possible to visualize mobility, analyse the causes of and predict congestion, and optimize mobility for the purpose of easing congestion.[60]

4.1.4 Smart agriculture

ICTs have great potential to accelerate the achievement of agriculture-related SDGs and targets at the national level. Strategic deployment can significantly facilitate the harnessing of this potential.

As the situation varies depending on the country or region, it is indispensable to develop an e-agriculture strategy appropriate to the situation of ICT and agriculture. Such a strategy should include an action plan, contribute to bringing the key stakeholders together, and build synergy in solution deployment. Thus, when actually implementing an ICT solution in agriculture, it will be essential to choose the most appropriate among the numerous solutions available.

For developing countries, where agriculture constitutes one of the largest parts of the national economy, provenance-supported value claims are seen as vital to future economic and social sustainability. It is therefore necessary to analyse what needs to be done at the global, regional and national level to introduce appropriate technologies aimed at improving food production,

[58] ITU-D SG2 Document SG2RGQ/186 from NEC Corporation (Japan)
[59] ITU. Final Report on ITU-D Study Group 2 Question 1/2 for the study period 2014-2017. Creating the smart society: Social and economic development through ICT applications. ITU, 2017.
[60] ITU-D SG2 Document SG2RGQ/73 from NEC Corporation (Japan)

quality and livelihoods in a sustainable manner and the collaboration, infrastructure, capacity and digital literacy components needed to achieve this.[61]

Faced with the urgent need to revolutionize traditional agriculture, the Food and Agriculture Organization of the United Nations (FAO), in consultation with stakeholders including the African Development Bank (AfDB), the Technical Centre for Agricultural and Rural Co-operation (CTA), the International Fund for Agricultural Development (IFAD), the Organisation for Economic Co-operation and Development (OECD), the World Organisation for Animal Health (OIE), the World Bank, the World Food Programme (WFP) and the World Trade Organization (WTO), as well as ITU itself, will develop a concept for considering the establishment of an international digital council for food and agriculture. The digital council will provide structured and strategic policy recommendations on the digitalization of food and agriculture, organize efforts to share best practices for smart rural communities, and promote interaction among countries and other stakeholders towards achieving the SDGs.[62]

In the past it was difficult to predict frost damage to crops. The implementation of an IoT sensor network has made it possible to issue frost warnings on the basis of temperature and moisture data in order to protect crops.[63]

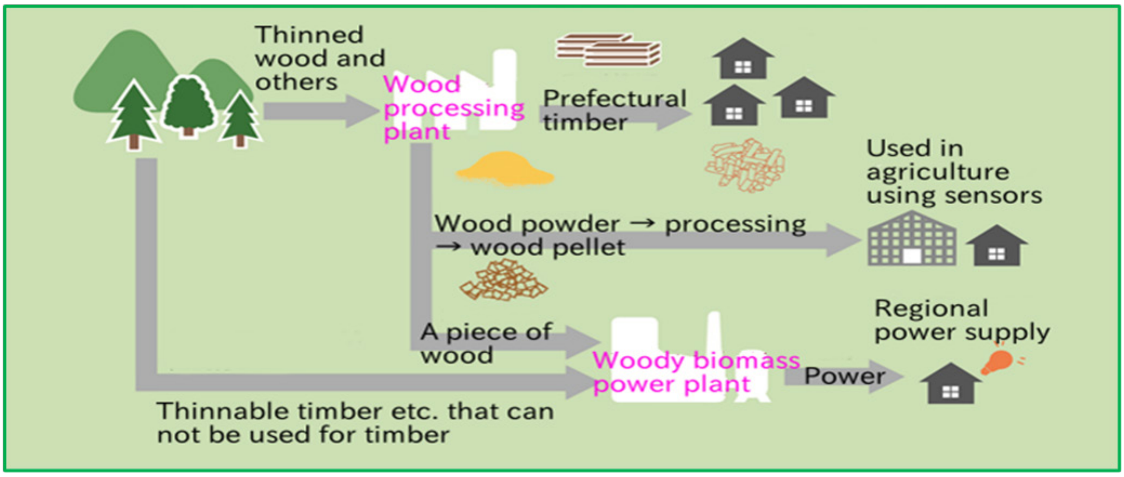
Using ICT and AI for hydroponics[64] in greenhouses is another cost-effective solution that increases productivity and reduces the workload for farmers. This method of cyberagriculture, which contributes to the vitalization of the regional economy, is of particular interest for arid and desert areas. This system, deploying various IoT sensors, shares the data obtained among sensors, sequencers and cloud-computing systems via communication networks, making it possible to display the status inside the greenhouse remotely to smartphones. By digitizing expert know-how, the nutrient solution irrigation settings can be properly controlled for each stage of the growth cycle.[65]

4.1.5 Energy

Natural and renewable energies are increasingly popular, in particular the production of energy using biomass. A biomass power plant contributes to establishing a regional industry chain from forestry and lumbering to the production of wood chips, to sustain an environment with forests and mountain ranges. By supplying energy to the electrical grid, biomass power plants strengthen the resilience of the ICT infrastructure and reduce greenhouse gas emissions in accordance with the SDGs.[66]

[61] ITU-D SG2 Document 2/200 from the BDT Focal Point for Question 1/2
[62] ITU-D SG2 Document 2/330 from the BDT Focal Point for Question 1/2
[63] ITU-D SG2 Document SG2RGQ/28+Annex from Japan
[64] Hydroponics is the above-ground cultivation of plants carried out on a neutral and inert substrate.
[65] ITU-D SG2 Document SG2RGQ/28+Annex from Japan
[66] Ibid.

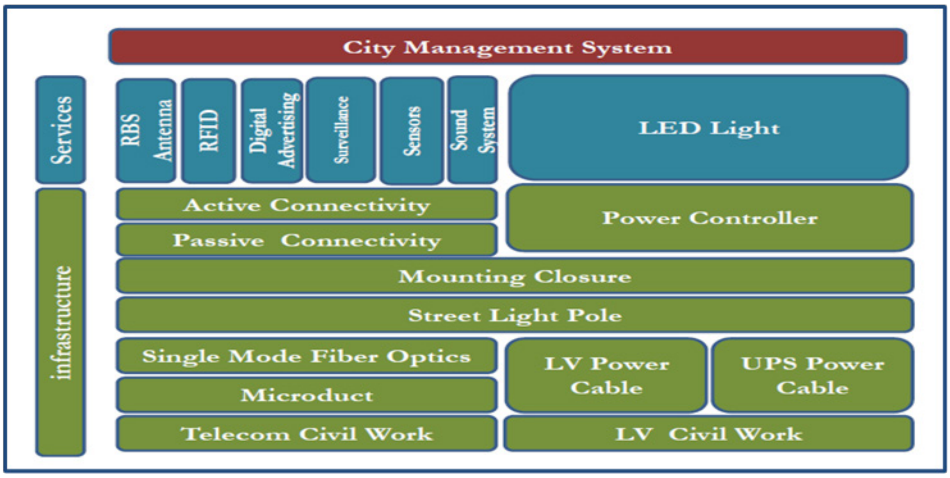
Figure 5: Regional power grid using biomass generation to supply ICT networks



4.1.6 Smart poles

Egypt has reported a smart-ready pole design that should provide consumption savings and enable services related to security, traffic and transportation management, with social and business benefits. The stakeholders include ministries and sectors such as housing, the interior, electricity, ICT and the environment, and municipalities for advertising, smart parking, etc.[67]

Figure 6: Smart pole components



China has also noted that integration of 5G and pole resources has begun to receive policy support in various countries. Smart poles can be connected to networks and platforms through different communication technologies, providing smart applications by enabling capacity technologies such as 5G, AI and big data.[68]

4.1.7 Learning

The problem of direct involvement in the region, with the development of a capacity-building programme on ICT skills, can be tackled upstream by offering an experience of engagement in

67 ITU-D SG2 Document SG2RGQ/195+Annex from Egypt
68 ITU-D SG2 Document SG2RGQ/226 from China

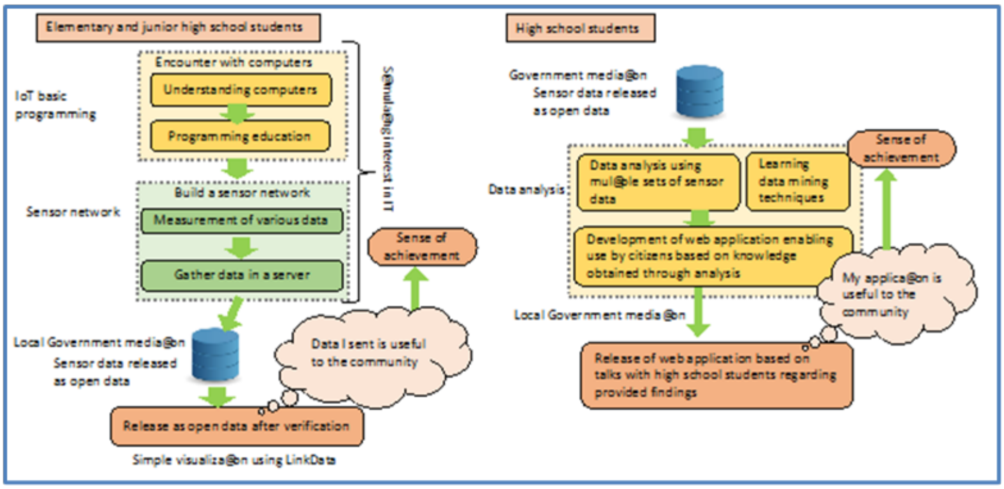
the region itself, giving students in elementary schools, colleges and high schools an opportunity to solve the real problems of the community with other stakeholders from the region using ICT.

This represents an opportunity for many countries faced with a shortage of human resources with technical skills in ICT to develop an educational strategy to retain the few local specialists, who often leave their region for big cities.

Requirements for curriculum and instructional aids

- allow students to learn how to solve local problems using computer technology;
- stimulate interest in ICT and develop the capacity to solve social problems;
- transmit advanced technologies and knowledge in fields such as IoT and data science;
- allow easy programming;
- be available at low cost and easily usable even at home;
- allow easy connection of external devices.

Figure 7: Example of curriculum currently under development



The local government can enable citizens to use the data, gathered by elementary and junior high school students, for easy visualization. Such data are then released as open data via LinkData modules. In this way, elementary and junior high school students can see how the system they have built is useful to the community, combining the learning experience with an appropriate sense of achievement.[69]

To cope with the spread of the COVID-19 pandemic, most governments around the world have resorted to temporary closures of educational facilities. The pandemic has highlighted new challenges requiring collective global action to mitigate the immediate impact of school closures, especially for vulnerable and disadvantaged communities, and to facilitate the continuity of education for all through distance learning.

With the sudden widespread adoption of distance learning, many questions have arisen such as management of the many teaching materials that are not accredited by credible institutions, and compliance with the rules relating to collection, management and use of data, in particular the personal data of children and young people.

[69] ITU-D SG2 Document SG2RGQ/161+Annex from Shinshu University (Japan)

While many virtual e-learning platforms have kept the relationship between teachers and students alive, fostering motivation, the pandemic has revealed the need to improve network connectivity in isolated regions in order to fight against inequalities, from which developed countries are not exempt. Thus, there is no doubt that this crisis will end up affecting all aspects of education in the future.

4.1.8 Digital government

Given the potential of ICT, the question for governments is how they can adapt their approach to adopt ICT and to ensure that this potential can make a difference in people's lives and the digital transformation, and how the potential of big-data analytics, AI and IoT can be harnessed to drive greater efficiency and sustainability in smart cities and societies worldwide.[70]

Intelligent governance refers to the use of information technology such as big data, cloud computing and IoT in the areas of city management, ecological environment, public safety and emergency/accident processing for accurate analysis, monitoring and feedback. Information technology not only provides tools for managing the public affairs of state and society effectively, but also brings about changes in the mode of social governance from government control to collaborative governance.[71]

Digital government means more than merely streamlining administrative procedures by paperless operation. Efforts should be made to digitalize procedures in all areas and at all levels of administration in all governments and throughout the private sector. Digital government strategy is of interest for all countries. As administrative procedures become digitalized, a method of personal authentication, such as a digital signature, needs to be considered. Mobile devices will become one of the essential tools of digital government. Going digital, which uses ICT, offers a social value of efficiency in terms of time and cost in the administrative procedures of all governments and the private sector.

The shift to digital government offers value gains in terms of security and equality. Some governments favour the introduction of a system which uses biometric data to identify and authenticate registered persons. The point of this personal authentication system is that governments provide public and financial services on an equal basis to all citizens and prevent illegal access, increasing well-being. Identity theft can also be prevented with the aid of fingerprints, physical images and iris images.[72]

Empowering citizens, especially vulnerable groups and women, through ICT is a necessary criterion to ensure equitable access to ICT infrastructure, facilitate access to public services and ensure digital inclusion of all parts of the country. An inequitably distributed information revolution risks widening the digital divide and increasing poverty in rural areas. This is why excluded regions and areas must be covered by ICT and applications, so as to minimize the gap between developed and underdeveloped regions.[73]

Digital transformation is seen as a broad umbrella for keeping pace with the continued rapid development of technology, contributing to business sustainability and competitiveness. A

[70] ITU-D SG2 Document SG2RGQ/TD/2 from the Co-Rapporteurs for Question 1/2
[71] ITU. ITU-D study groups. Annual deliverable report on ITU-D Study Group 2 Question 1/2 for the study period 2018-2021. A holistic approach to creating smart societies. July, 2019.
[72] ITU-D SG2 Document SG2RGQ/73 from NEC Corporation (Japan)
[73] ITU-D SG2 Document 2/72(Rev.1) from India

national digital transformation strategy is part of a country's efforts to achieve the SDGs adopted by the United Nations in 2015.[74]

As smart cities and smart societies are unachievable without digital literacy, the development of skills is an important component in the creation of smart cities and smart societies. Thus, Brazil has a variety of smart-city projects, and the successful ones are linked to the development of human skills needed to deal with digital government and the digital world.[75]

4.1.8.1 Digital identity

Digital identity is a huge and complex problem that spans several dimensions. It covers areas such as governance, general policies, operations, technology and legislation. All stakeholders in the public and private sectors can thus participate in the development and implementation of a national digital identity framework: government members, regulatory authorities, judicial authorities, ICT providers, operators of essential infrastructure, civil society, academic institutions and research institutes.[76]

Approaches to the implementation of digital identity:

- fundamental cross-cutting considerations when developing a national digital identity framework;
- areas of intervention, identification of key elements and subjects to take into account when developing the framework;
- guidelines for the development of a national digital identity framework: stages in the development of the framework throughout its lifecycle;
- critical success factors and conflicting principles: factors that could improve the prospects of success for the national digital identity framework and those that threaten to slow the process, forcing national leaders and policy-makers to exclude certain conflicting aspects in favour of others.

4.1.9 Smart devices

In the IoT context, things are objects (physical or virtual) which are capable of being identified and integrated into communication networks. Things have associated information, which can be static or dynamic.[77]

- Physical things exist in the physical world and are capable of being sensed, actuated and connected. Examples of physical things include the surrounding environment, industrial robots, goods and electrical equipment.
- Virtual things exist in the information world and are capable of being stored, processed and accessed. Examples of virtual things include multimedia content and application software.[78]

The value of IoT is not in the devices or the data, but in the analysis and understanding of the information the data represent.

74 ITU-D SG2 Document SG2RGQ/230 from the State of Palestine under Resolution 99 (Rev. Dubai, 2018)
75 ITU-D SG2 Document SG2RGQ/273 from Brazil
76 ITU-D SG2 Document SG2RGQ/56+Annex from the BDT Focal Point for Question 1/2
77 Dimitri Konstantas, University of Geneva. Internet of Things: challenges and opportunities. Keynote address. *ITU-D session on IoT for development: opportunities and risks for developing countries*. February 2020.
78 Recommendation ITU-T Y.4000. Overview of IoT.

4.1.9.1 Universal data terminal based on narrowband IoT

The data terminals widely used by industries today are developed specifically for relevant application scenarios, with sensing devices to be used in those scenarios already integrated in the terminals.

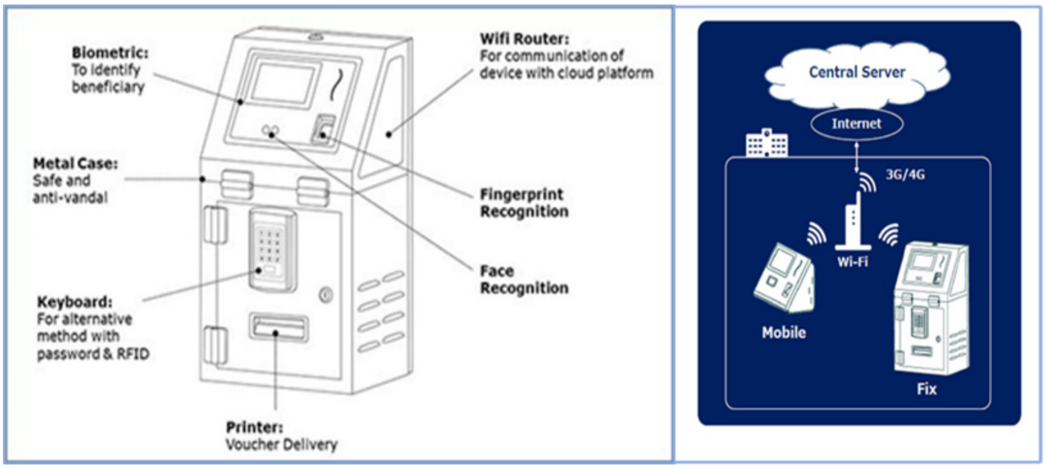
With in-depth development of narrowband IoT (NB-IoT) technology in multiple fields for deep coverage, such as light-current equipment rooms in buildings, underground garages, underground pipelines, grasslands, forests, mountains, rivers and lakes, etc., the technology involved is becoming ubiquitous in industry. Typically, it relies on an NB-IoT universal module which includes a microcontroller unit (MCU module), a communication module, an interface module, a power-supply module and a memory, with a terminal for wireless network access.[79]

4.1.9.2 Biometric identification terminal

A biometric authentication system is used for authentication of fingerprint and face recognition and can be a good example of digital government in action. It makes it possible to accurately verify and validate eligible recipients, trace correct delivery of designated supplies, minimize waste, and monitor and improve the efficiency of distribution programmes.

As a security measure, given the sensitivity of biometric data, data are transmitted between the central server and dedicated terminals installed on the premises on the basis of identification by means of an ID number (i.e. no names are sent or received), to prevent leakage of personal information.[80]

Figure 8: Biometric authentication terminal



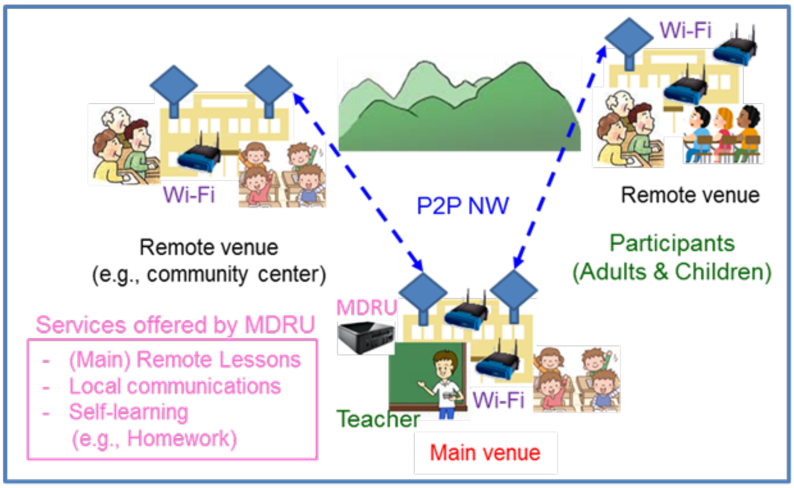
4.1.9.3 MDRU

Emergency telecommunication systems such as a movable and deployable ICT resource unit (MDRU) can be adapted to provide other useful services to rural areas where the telecommunication environment is not sufficient.

[79] ITU-D SG2 Document 2/54 from China
[80] ITU-D SG2 Document 2/207 from NEC Corporation (Japan)

Thanks to its IP-PBX functionalities and the exchange of files via Wi-Fi, the MDRU can overcome geographical barriers to serve difficult areas, in such domains as remote education of children and remote agricultural consultation for farmers.[81]

Figure 9: Remote education testing



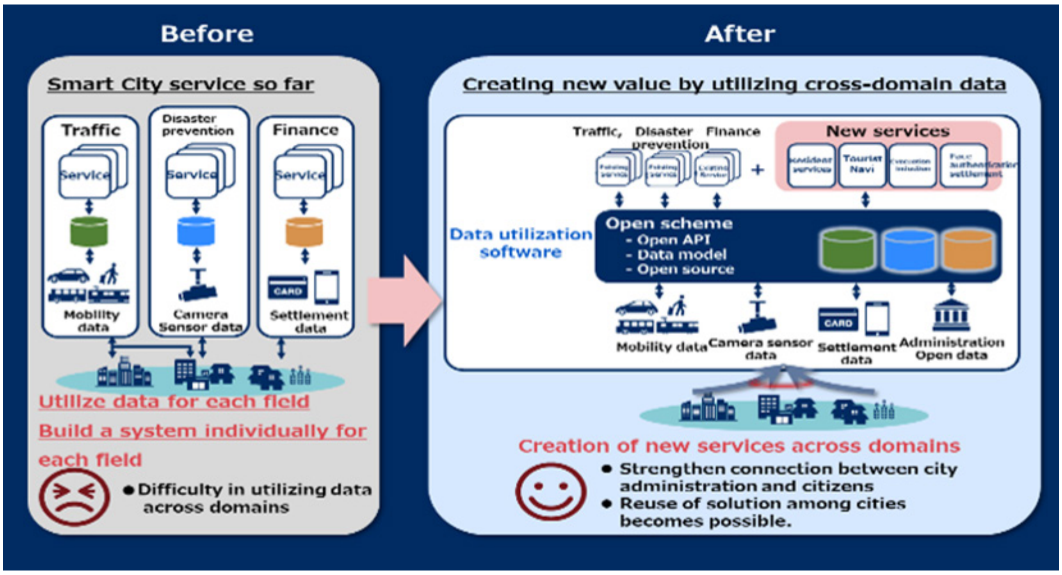
As an incidental benefit, broad adoption of this resource for non-emergency use will foster familiarity and thus preparedness for disaster situations, and improve resource readiness by avoiding prolonged inactivity.

4.1.9.4 Software development

When building new networks of environmental sensors for the smart city, it is possible, rather than collecting and managing databases subdivided into categories as in the past, to use software-defined networking (SDN)[82] technology and data-utilization software for using open-source software. SDN separates network control from data transfer processing and dynamically controls devices that only perform data transfer processing with software. The main advantage is that it is a much more flexible, efficient and safe approach, meaning that it is possible to adapt network bandwidth in real time. For example, a data-utilization application[83] for linking data across different sensors and different fields was developed and first implemented in Europe. It is centred on context information management functions to realize a data-centric society. As a result, data-management costs can be significantly reduced, which is especially important for developing countries when planning and deploying the network infrastructure of environmental sensors.[84]

81 ITU-D SG2 Document SG2RGQ/188(Rev.1) from Japan
82 Software-defined networking is a new concept for dynamically controlling a network and its architecture using software.
83 FIWARE is data usage software making it possible to link the data distributed between different sensors and different fields. It is an open architecture which maximizes the benefits offered by open-source software (OSS) without depending on a single ICT vendor.
84 ITU-D SG2 Document 2/208 from NEC Corporation (Japan)

Figure 10: Feasibility study of data-utilization software



4.2 Safety and trust

In smart cities and communities, the data generated, collected and used by connected objects are myriad and diverse. Massive data collection brings with it potential vulnerability to attacks targeting connected devices. Proportionate, risk-based solutions can help prevent attacks and provide protection, addressing issues such as infrastructure vulnerability, trust in connected objects and protection of personal and proprietary data.

For the construction of new smart cities and communities, as well as the addition of new smart applications to existing communities, designers should follow an approach inspired by sustainable development based on traditional community development planning in line with an assessment of user/stakeholder needs. Similarly, the proportionate and legal use of massive data generated by the city's activities can enable better planning. As smart city and community development and implementation occurs, we observe that data derived from new applications are driving decision-making across disciplines at the city, state/provincial and regional level.

Policy-makers must also address in their planning the need to securely generate, transmit and store the massive amounts of data that will be a defining feature of smart cities and communities.

4.2.1 Building trust first

Successful smart cities and communities and the applications they use must rely on the implicit trust of consumers if they wish to see mass adoption. The concept of smart cities and communities encompasses the notion of safe and trusted cities. Cybersecurity, when factored into the design of smart-city projects and applications, is key to promoting and maintaining trust. Trust is one of the most important considerations for residents of cities and communities, and the need for trust and public safety is well understood.

The contributions received reflect this: the concept of trust in smart cities and societies includes cybersecurity, cyberhealth, disaster management and public safety. These categories do not stand alone but are interconnected. Consequently, all measures and systems should be considered. For example, a big challenge for policy-makers is how to manage networked government services efficiently and sustainably, while protecting personally identifiable information.

There are several factors behind the importance of trusted smart-city infrastructure for the development of the IoT and smart cities.

One potential risk for trust in smart cities is a city's adoption of hardware and software before all critical systems have been tested. City/community leaders should pursue risk-mitigation strategies when planning for the introduction of new hardware and software systems, including accountability measures for both procurement officials and vendors. Policy-makers and other decision-makers should also consider the use of open-source software, which allows for independent testing and public review for vulnerabilities and effectiveness.

Malicious cyberactivity can impact critical infrastructure, which could, for example, lead to disrupted services in critical sectors, including power outages, malfunctions in hydroelectric dams and the hacking of water-treatment facilities. There are direct risks to the security confidentiality, availability and integrity of the system, with the potential for the subsequent manipulation of sensitive data.

4.2.2 Infrastructure risk management

4.2.2.1 Stakeholders

Securing infrastructure when creating smart cities is a task that depends on the participation of all stakeholders. These typically include:

- network providers;
- device providers;
- platform, software and/or application providers;
- community leaders (both elected and appointed);
- citizens, universities, schools, hospitals, museums, light and heavy industry, etc.

4.2.2.2 Risk categories

Infrastructure risk management seeks to address several risk categories, including at least three broad scenarios:

- Denial-of-service attacks on critical facilities: This occurs when a perpetrator seeks to render a network resource unavailable to users by temporarily or indefinitely disrupting services of a host, often by overwhelming the host's ability to respond to requests. Denial of service can represent a significant threat in a universally connected world.
- Remote takeover of public or private facilities, in which unauthorized users gain access over connected systems: This is a major risk associated with the sharp rise in the number of connected objects. If risk mitigation is ineffective, it is relatively easy for a malicious actor to penetrate a connected device, then a network, etc. and laterally move through infrastructure. With networked objects being by definition interconnected, if even one is vulnerable, then all objects on the same network may become vulnerable.
- Theft of proprietary or personal data: Consumers are increasingly concerned about the protection of their personal data and do not wish to expose their data to risk. In a connected world built on a foundation of data, the security of the systems that process data from consumers, residents and applications is paramount to building and maintaining trust.

It would be appropriate to establish a trust-based strategy and mechanisms capable of detecting and mitigating vulnerabilities at the different hardware and software layers. The strategy should include the ability to determine appropriate controls and measures to mitigate these vulnerabilities. In addition, there should be a complementary strategy to detect compromise, alert relevant stakeholders, and inform management and resolution strategies. A secure-by-design approach should be taken when developing and deploying IoT services and infrastructure that runs through the full development lifecycle, encompassing design, development and deployment. This includes designing appropriate security and trust domains across the architecture to minimize the likelihood and effects of threats.

4.2.3 Confidentiality of personal and proprietary data

People are increasingly concerned about the protection of their personal data. Some of these concerns relate to digital identification, data protection and the protection of personal data. The introduction of robust and inclusive identification systems can contribute to the efficient, precise and secured use of data. Robust identification systems have the capacity to establish not only the existence of persons within a specific jurisdiction, but also their uniqueness. There are at least three different models that can be adopted to manage a framework for digital identification, namely:

- The government is directly involved as the identity service provider.
- The government is not the identity service provider; it acts only as the regulator and provides resources such as best practices and guidelines for the private sector and other stakeholders.
- The government acts as the regulator and identity broker/clearing house, while the private sector or other stakeholders act as identity service providers.

4.2.3.1 Examples of digital identification

India: Aadhaar and DigiLocker are biometric systems in which a random 12-digit number is assigned as a unique identity to each Indian citizen. DigiLocker is a key initiative under Digital India, which is the Indian Government's flagship programme to transform India into a digital society and a knowledge-based economy.

Estonia: The e-Estonia platform operates using a chip-based identification system. The government provides a PIN code to each national, based on physical identifiers, which provides access to a wide range of government services.

United Kingdom: Gov.UK Verify allows individuals to choose a government-approved identity provider, which provides a single connection and, thereby, access to government services.

Denmark: NemID in Denmark is a digital identification platform which provides access to public- and private-sector services.

4.2.3.2 Regulatory and policy approaches

Interest in the issue of data protection has increased in recent years, particularly in the light of the European General Data Protection Regulation (GDPR). In Europe, the rise of the digital economy and changes in uses have compelled the European Commission to revise its rule book on the protection of personal data. Many other governments around the world are taking a variety of approaches to addressing these issues, such as drafting new data-protection laws, revising existing laws to accommodate the growing digital economy, or using sector-specific approaches (e.g. financial, insurance, health).

Some person-specific data may be processed based on obtaining the consent of the individual, or based on the legitimate interest of the person collecting the data, or to fulfil a contract, for example. More sensitive data, such as biometric data for identification and genetic data, are often subject to special requirements. For example, the collection and processing of sensitive data may be prohibited, or only permitted with consent or to protect the data subject's life (in circumstances where they are unable to provide consent). Sensitive data generally refers to data liable to reveal, directly or indirectly, racial or ethnic origins, political, philosophical or religious convictions, trade-union affiliations or information on health or sex life.

4.2.3.3 Directives and standards for digital identification approaches

As noted above, different governments and organizations vary in their support for national-level digital identification, and some have developed standards that could be of great use in the design and implementation of a national framework for digital identification and data security. Some of the most relevant examples are listed below:

- ISO/IEC standard 29115: "Information technology – Security techniques – Entity authentication assurance framework", a working framework for managing entity authentication assurance in a given context[85]
- ISO/IEC standard 24760-1: "Information technology – Security techniques – A framework for identity management"[86]
- Recommendation ITU-T X.1253, on proposed security guidelines for identity management systems.[87]

Guidelines are being developed in multiple countries, such as Canada (IAM), the United Kingdom (IDAP) and the United States (NSTIC), to address possible identification, authentication and security concerns. As part of its collaboration with the United Nations, the World Bank group has produced a number of useful publications, including principles on identification.

4.2.4 Trust in IoT peripherals

Smart cities can be used to leverage digital integration to offer more efficient and effective services.[88] Inevitably, not everything is straightforward in smart cities. Some people may be wary of using and sharing their personal data, which complicates efforts to bring new technologies online at the city level.

Many smart cities are leveraging an increasing number of IoT devices, which can enable connectivity, communication and other smart-city applications. While the IoT and faster data processing continue to drive smart-city development, they also increase the need to promote trust and risk management. The very fact of connecting simple everyday objects, such as televisions, light bulbs and so forth, to a network represented a major technological

85 ISO. ISO/IEC standard 29115 (2013)
86 ISO. ISO/IEC standard 24760-1 (2019)
87 Recommendation ITU-T X.1253
88 Chris Teale. Report: Smart city technology could dramatically improve quality-of-life indicators. June, 2018. According to this study, cities could reduce daily commutes by 15-30 minutes and crime by 30-40 per cent, improve emergency service response times by 30-35 per cent and even save 25-80 litres of water per person per day.

breakthrough. With these new connected objects generating such positive results, issues of identity and access management were often neglected in the past. Now that IoT switches are gaining in maturity and stability, the vulnerabilities and potential risks of data loss are better understood and the management of such risks for collected data is a higher priority.

4.2.4.1 Potential measures to consider

To promote trust and therefore further consumer adoption, various measures are being introduced into IoT applications, products and services. The following actions are worthy of consideration:

- Promote validated identities for smart-city infrastructure, such as having a validated identity for each connected device within the smart-city infrastructure, whether it be a streetlamp, an earthquake detector or a car, and having them properly connected to the network, with authorization for the connection and for participation in the service.
- Adopt a protection-by-design approach for data.[89]
- Have unique login credentials that require users to change them on first use in order to avoid brute force attacks, which rely on weak passwords and default login details.
- Protect network access with strong authentication measures, which could include incorporating biometric authentication in IoT devices, which would help to better reassure users.[90]
- Use strong data encryption; this measure concerns both storage and network for devices which are capable of this work.[91]
- Regularly release updates, and consider doing so via a secure channel: this helps to maintain the device through its life and keep it up to date as regards security.
- Dedicate resources to ensuring cybersecurity of critical systems and overseeing the smart-city network as a whole.

4.2.5 Case studies and practices

In order to resolve some issues associated with smart cities, cities and companies around the world are establishing what is sometimes called a city brain: a control centre to manage smart-city data generation, transmission and storage.

In China, city brains have been created in Hangzhou, Macao and other cities. A city brain is a platform-type AI centre built on the innovative use of big data, cloud computing, AI and other cutting-edge technologies in accordance with the urban science theory of urban life and the concept of Internet plus modern governance.[92]

In Egypt[93], the smart city architecture involves two city brains or main centres: (i) a command and control centre (CCC) that manages and handles all critical and sensitive data and (ii) a city operation centre (COC) that handles and manages operational data and services.

The city of Shiojiri in Japan provides an example of how software-defined networks and data-utilization software can resolve some smart-city issues and challenges facing residents

[89] This approach both shows that the protection of privacy and non-disclosure of personal data are priorities and allows for the protection of privacy to be incorporated in processes, procedures and activities of organizations from the outset rather than in retrospect.
[90] ITU-D SG2 Document SG2RGQ/73 from NEC Corporation (Japan)
[91] ITU-D SG2 Document 2/198 from China
[92] Ibid.
[93] ITU-D SG2 Document SG2RGQ/70 from Egypt

and communities. It also demonstrates how the city's programme uses its data to provide information to facilitate services, such as for natural disaster management, crime prevention, tourism, agricultural support, etc.[94] Location big-data analysis tools in smart cities were among the tools employed in the COVID-19 response of local governments nationwide, for example by obtaining location information for consenting users' mobile phone terminals.[95]

In Spain, Barcelona has established an urban operations and management centre to integrate all collected urban data, covering eight sectors: transport, property, security, business services, education, healthcare, sports and leisure, and government.

In the United States, New York City uses its intelligence operations centre to support data-driven decision-making by integrating different data from various departments, including geographical information, GPS, 3D construction, statistics, cameras, etc., which enhances communication between each sector thanks to different data fusions in a unified data platform. The data are anonymized to protect residents' personal data.

In the Republic of Korea, Busan is one of the leading cities in the integration of ICTs in urban services and operations. The Busan pilot city project seeks to serve as a model of tomorrow and to create economic opportunities for economies that have adopted the technologies of the fourth industrial revolution.[96]

[94] ITU-D SG2 Document 2/208 from NEC Corporation (Japan)
[95] ITU-D SG2 Document SG2RGQ/243 from KDDI Corporation (Japan)
[96] ITU-D SG2 Document 2/219 from the Republic of Korea

Chapter 5 – Key performance indicators for sustainable cities and communities

5.1 Introduction

Integration of ICTs into existing urban services in smart sustainable cities (SSCs) can assist in improving the energy efficiency, operation and transparency of the urban infrastructure, resilience of road networks, intelligent transport systems that improve urban mobility, efficiency of water distribution systems, wastewater management, and security. Since building smart cities is a complex process, it is important to be able to measure the performance of various SSC ventures.

One approach uses key performance indicators (KPIs) to facilitate monitoring of the progress achieved in the SSC transition. These indicators provide a consistent and standardized method for collecting data and measuring performance and progress towards achieving the SDGs and establishing a smarter and more sustainable city.

The KPIs for an SSC aim to assess how the use of ICTs has an impact on the environmental sustainability of the city. Each indicator forms part of a holistic view of the city's performance in three dimensions: economy, environment and society and culture. Each of these dimensions provides a separate view of progress that, when reported together, gives a holistic view of the SSC. Within each dimension, there can be sub-dimensions that focus on more specific areas of performance and progress.

The indicators are further subdivided into core and advanced indicators. Core indicators are those that should be within the scope of reporting for all cities. They provide a basic outline of smartness and sustainability. Advanced indicators provide a more in-depth view of a city and measure progress on more advanced initiatives. The selection of KPIs needs to be based on the principles of comprehensiveness, comparability, availability, simplicity and timeliness.

Implementing SSC KPIs helps businesses to grow by boosting performance and the consistency of outcomes. The KPIs also serve to demonstrate the feasibility of progressing rapidly towards efficient energy and clean climate objectives at the city level, while proving to citizens that their quality of life and the health of the local economy can be improved by consistently measuring energy efficiency and reduction of carbon emissions using ICTs.

Below we list some activities related to smart-city KPIs and rankings. The list is not meant to be exhaustive; it reflects only those entities from which we have received contributions or which are covered in other contributions and events related to the Question under study.

5.2 U4SSC initiative and KPIs

United for Smart and Sustainable Cities (U4SSC)[97] is a United Nations initiative to achieve SDG 11: Make cities and human settlements inclusive, safe, resilient and sustainable. U4SSC developed a set of SSC KPIs:

- to establish criteria for evaluating ICT's contribution in making cities smarter and more sustainable;
- to provide cities with the means for self-assessments in order to achieve the SDGs.

The advantages of the U4SSC KPIs include:

- first and only international standard supported by 16 United Nations agencies and programmes;
- policy tool;
- general screening of the city to identify areas of improvement and give cities the opportunity to assess their own progress;
- potential for cities to develop better strategies for management of the city;
- possibility for cities to compare themselves with other cities, paving the way for international collaboration;
- assistance to cities in achieving the SDGs.

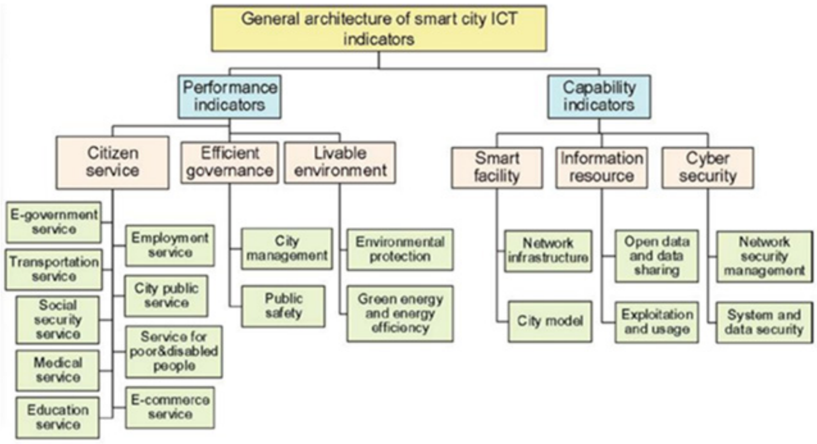
The U4SSC KPIs consist of 91 indicators. Each indicator forms part of a comprehensive view of a city's performance in the three above-mentioned dimensions (economy, environment and society and culture), providing both a granular view of progress and a holistic view of the SSC when reported together.

5.3 ISO/IEC KPIs

Joint Technical Committee 1 (JTC 1) of the International Organization for Standardization (ISO) and the International Electrotechnical Commission (IEC) on ICT standards has been actively working on developing indicators for smart cities.[98] **Figure 11** illustrates the general architecture of smart-city ICT indicators. JTC 1 classifies KPIs as performance or capability-related indicators. In turn, performance indicators are broken down into citizen service, efficient governance and liveable environment; while capability indicators refer to smart facilities, information resource and cybersecurity.

[97] Annex 6 to ITU-D SG2 Document 2/TD/20 from BDT
[98] Annex 5 to ITU-D SG2 Document 2/TD/20 from BDT

Figure 11: ISO/IEC JTC1 information technology smart-city indicators



5.4 EasyPark index

Some cities, such as Geneva,[99] are adopting the ranking of the EasyPark index,[100] which consists of seven main pillars (including more than 20 indicators):

- transport and mobility
- sustainability
- governance
- innovation economy
- digitalization
- living standard
- expert perception.

5.5 Example of KPI-based evaluation of a smart city: China's new smart-city evaluation index system

China has developed a feedback mechanism to adjust the construction of the next stage of smart cities, so as to form a closed-loop iterative construction model, which can guide the construction of smart cities, enabling them to be developed in a healthy manner in the direction of self-improvement and self-adaptation. During its first-ever evaluation of the effects of smart cities conducted in 2017 in 220 Chinese cities, deficiencies were observed such as focusing more on construction but less on effects of application, and fragmentation of data. China's new smart-city evaluation index system targets the application effect, tries to dynamically and quantitatively monitor the construction of smart cities, and promotes the smooth development of smart cities towards standardization and harmonization, co-construction and sharing, and focused effectiveness. The system has developed a series of evaluation indices, currently including 8 primary indices, 21 secondary indices, and 54 secondary index sub-items, to implement quantitative evaluation of the city's current status, development space, development characteristics, etc. so as to reflect the country's latest requirements and promote faster and better construction and development of smart cities.[101]

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[99] Gianfranco Moi. Geneva's 'Smart Canton'. *GMIS-UNIDO-ITU special session on Technology and Innovation Powering Connectivity for Inclusive and Sustainable Industrial Development*. October 2018.

[100] EasyPark. Smart Cities Index 2019

[101] ITU-D SG2 Document 2/52 from CITCC (China)

Chapter 6 – Conclusion

Public funding combined with private-sector participation in projects enhances the capability and capacity of city governments in developing economies to implement their infrastructure projects, as traditional funding approaches will indeed not be sufficient to meet their significant infrastructure needs.

Nonetheless, the challenge remains: how to decrease risk and provide adequate return to private investors interested in providing debt and equity capital in these markets. Part of the solution will be through city governments and project teams accurately evaluating the projects' business models and attracting investors to finance specific portions of the projects, based on their preferences. The other part of the solution involves IDOs continuing to support the expansion of private financing for infrastructure, through financial instruments that the private sector can leverage and with guarantees against project-specific risks.

In an evaluation of the effects of smart cities conducted in 2017 in 220 Chinese cities, some common deficiencies were found:

- *Focusing more on construction but less on application*. A large proportion of resources has gone into the construction of infrastructure, such as data centres and cloud platforms, but the infrastructures have not been used to the full. The focus in the future should be on how to make good use of these infrastructures. The various stakeholders in society should work together and use them for the benefit of all.
- *Fragmentation of data*. The key to smart cities is data sharing and openness. The existence of a large number of information silos has caused much data to be isolated between departments and industries. As a result, the exchange and circulation of data are hindered. The fragmentation of data is now a core issue faced in the construction of smart cities.

Smart cities and communities are intended to elevate the level of knowledge, boost the economy and improve social and cultural aspects. It is necessary to go beyond the limited view of construction and expansion of buildings and data centres and, in this era of smartness and digitalization, focus on how to integrate different sectors under the enabling ICT platform so as to improve management efficiency and performance, reduce cost by having common building blocks for systems operation, and involve citizens and developers in the developing process through an enabling and open platform that allows for dynamism in the city/community rather than being a one-time product.

It is worth mentioning that smartness cannot be brought about at once but needs to be implemented in phases, based on well-planned priorities and on the type and nature of each city and place. Sustainability is a crucial objective that needs to be well considered in all of the planning phases; otherwise, cities and communities will soon deteriorate and the whole model will collapse.

The unexpected COVID-19 crisis has shown how essential ICT networks and services are, both to deal with the current pandemic and to manage disasters. The health crisis has also shown that it is necessary to move away from the naive vision of the smart city by accelerating the digital transformation of society, determining the priorities in terms of innovation. In addition to allowing all those who can to work from home and to make online transactions, there is an urgent need to respond to the closure of schools, taking advantage of digital tools to help countries develop the most suitable distance-learning solutions for as long as pupils and students around the world do not have access to their place of learning. In this situation, digital platforms have been the hidden hero of the crisis.

At the initiative of ITU, a global platform called #REG4COVID[102] to guarantee continuity of service during the crisis has been launched. This involves informing national political decision-makers, regulators and operators but also hospitals, businesses and civil society to ensure that telecommunication networks and services, from the Internet to mobile-telephony lines, continue to meet basic needs despite the massive increase in traffic.

[102] ITU. The Global Network Resiliency Platform (#REG4COVID)

Annexes

Annex 1: Case studies - success cases

Success case 1: A sustainable smart society

In Shiojiri city (Japan),[1] located in a seismic zone and subject to many climatic hazards, smart data-collection platforms and associated IoT sensor networks have been installed to better manage the city and prevent disasters. The networks include: a monitoring system for children and elderly people, soil moisture sensors, level sensors for watercourses, bus geolocation sensors, wildlife damage protection sensors, radioactivity sensors, personal safety sensors, agricultural sensors, sensors for monitoring the structure of buildings, dam inclination sensors (inclinometers), and environment monitoring sensors.

[1] ITU-D SG2 Document SG2RGQ/28+Annex from Japan

Success case 2: Cyberagriculture

Another document from Japan[1] describes how ICT has been applied to farming by an IT company, Daiwa Computer Co., Ltd., for producing high-value muskmelons in greenhouses. This contributed to generating income for the company and collaborating farmers, and stimulated the regional economy. Local government, IT companies and academia collaborated in this project.

This method of cyberagriculture is of particular interest for arid and desert areas. It will be of one of the good practices of future e-agriculture applicable in developing countries for crops other than muskmelon.

[1] ITU-D SG2 Document SG2RGQ/29+Annex from Daiwa Computer Co., Ltd. (Japan)

Success case 3: Smart device

A document from China[1] describes asset security monitoring using a universal data terminal with the NB-IoT protocol. The terminal includes a microcontroller unit (MCU module), a communication module, an interface module, a power-supply module and a memory. The MCU module is separately connected to the communication module, the interface module and the memory. The communication module is the NB-IoT wireless communication module used for receiving or transmitting data. The interface module includes an RS485 interface, a UART interface, an I2C interface and several GPIO interfaces. The power-supply module provides power to other modules and the memory. The multiple interfaces are installed in an integrated way in the terminal to connect to sensors and smart devices, which solves the issue of making data terminals universally applicable to different industries and application scenarios. The terminal supports a 220V AC power supply, but the terminal can operate autonomously under battery power for three days or more without an external power source.

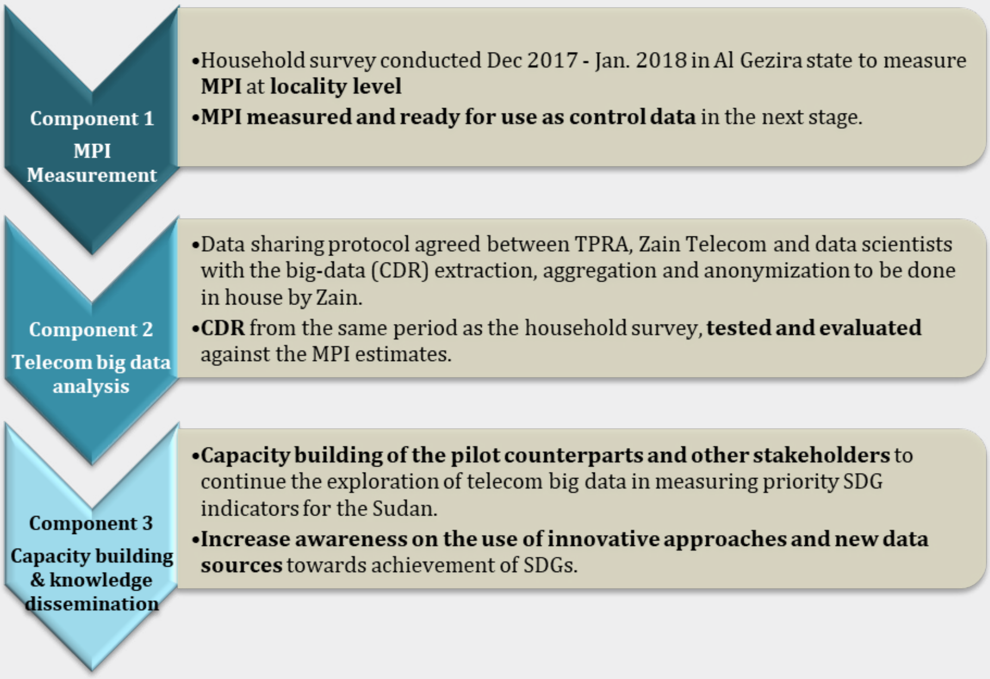
[1] ITU-D SG2 Document 2/54 from China

Success case 4

A document from the Sudan[1] proposes a concept particularly suited to countries with limited resources, under which big data from call detail records (CDR) can be used as an indirect indicator for measuring multidimensional poverty in the shape of a composite multidimensional poverty index (MPI).

Approach and pilot components

Results:



- MPI and CDR covariates show high correlation ($R^2 > 0.9$, adjusted $R^2 \sim 0.75$), demonstrating that mobile-phone use metadata can serve as proxy indicators of poverty at the locality level.
- MPI is a deprivation indicator, hence the proxy poverty levels make impact level predictions but not at the sectoral level at this stage. This opens an avenue for further research.
- The scaling potential of the approach in a comprehensive fashion can be improved with additional validation data along time and cross-sectional dimensions.

[1] ITU-D SG2 Document 2/146 from the Sudan

Success case 5: A smart city brain

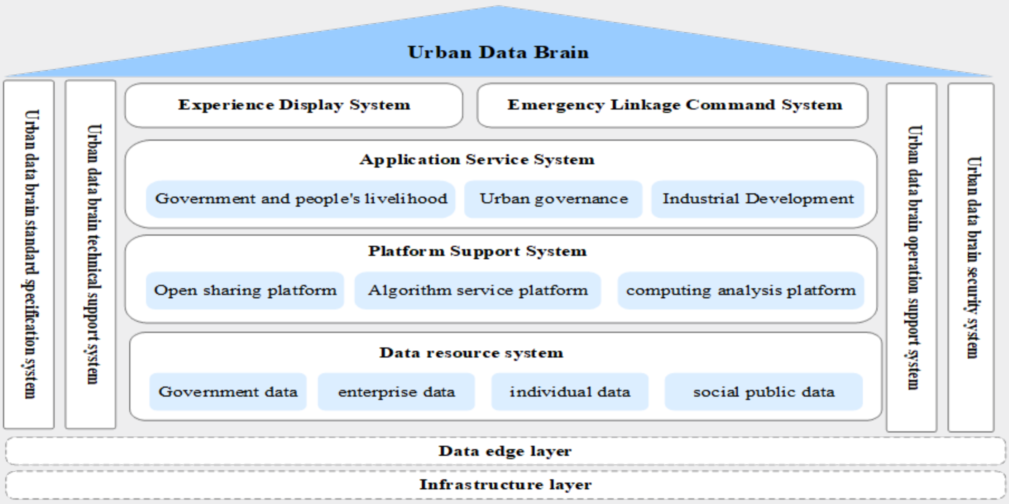
Another document, from China,[1] describes the city brain, a platform-type artificial intelligence centre based on the innovative use of big data, cloud computing, artificial intelligence and other cutting-edge technologies in accordance with the urban science theory of urban life and the concept of Internet plus modern governance. The city brain aims to integrate the data resources of government, enterprises and society, conduct fusion calculation in the field of urban governance, and realize the functions of vital signs perception, public resource allocation, emergency decision-making and command, event prediction and early warning of urban operation.

To become a smart city, it is necessary to use the data collected by existing infrastructure, but without demanding a lot of hardware, so as to avoid waste and duplication in investments and construction.

The smart-city brain is guided by the government, driven by the market, and combined with the actual development needs of the city, while being planned and deployed in a coordinated and orderly manner. Furthermore, in order to ensure the safety, stability and efficiency of the construction and operation of new smart cities, it is paired with a sound network structure and a sound system of standards for safety and controllability. A specialized agency managed by the government is responsible for building and operating the city's brain and urban data resources. The urban data resource management system will be put on a firm statutory footing and recognized as a strategic resource. It will also be important to specify clearly the requirements in terms of aggregation, sharing, exchange and open analysis of data resources.

City brain architecture

The advent of the city brain should open up various systems and technology platforms on the basis of current urban informatization, strengthen the integration and open sharing of data resources, and aim at uniform standards, architecture and management.



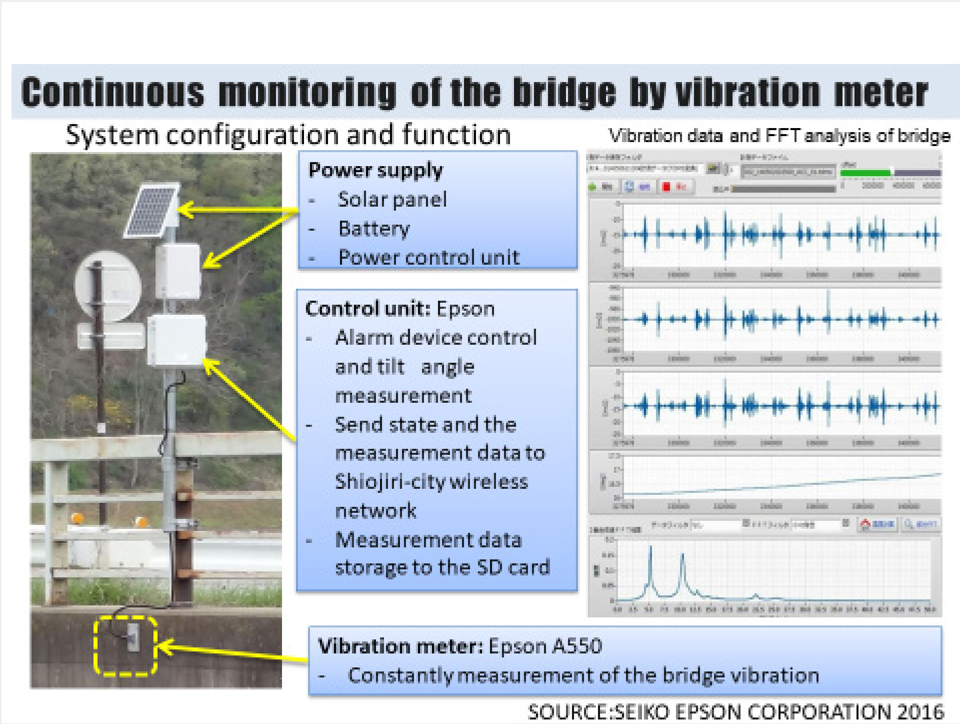
[1] ITU-D SG2 Document 2/198 from China

Success case 6: Smart building

A document from Japan[1] presents building structure sensors that monitor the state of ageing public structures, in particular bridges, by detecting abnormalities in the characteristic vibration of structures. This information is useful for decisions on measures required to prevent further deterioration. The condition of bridges and tunnels in the public infrastructure has become a matter of concern due to ageing.

A dam inclination sensor system is presented, which detects signs of deterioration that could lead to dam failure. This is done by measurements taken inside and outside the dam barrier. Any sudden deterioration can be registered and notified to the local residents by wireless transmission.

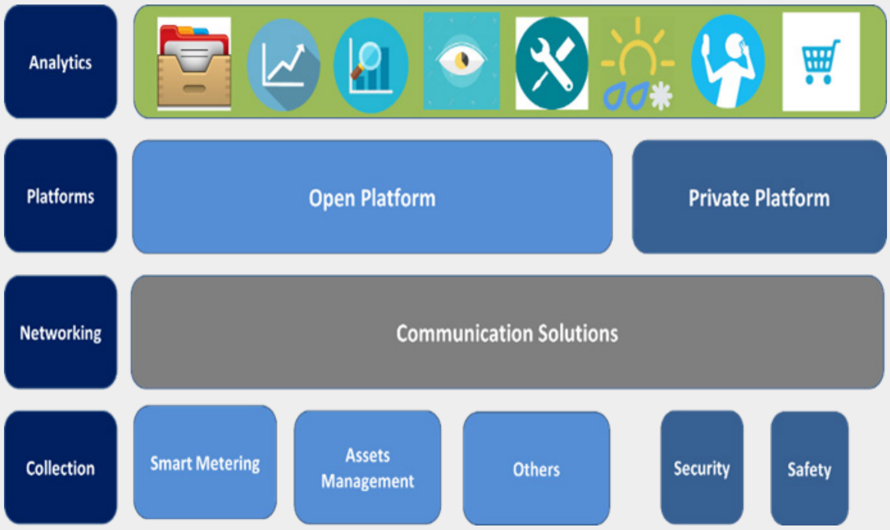
Building structures monitoring system



1 ITU-D SG2 Document SG2RGQ/28+Annex from Japan

Success case 7: Safe and smart architecture

A document from Egypt[1] presents the architectural concept of a smart city that encompasses four main layers: data collection, networking and communication, platform, and analytics. It treats data collection in two different classes of information: security information (such as that collected from CCTV cameras) and smart information (relating to smart services).



Platforms may be open or private. An open platform could be responsible for managing the smart information class, while the private platform is more suitable for managing the security information class. Another solution is to have a single platform managing the two classes of information. Both choices depend on the level of data security and conservation that each city requires. In the context of the layered architecture presented in the document, two main centres should be considered in the architecture of a smart city:

1. Command and control centre (CCC): Its purpose is to collect and process all critical data for security in order to guarantee the security of the city. It deals with sensors/security cameras and uses a private platform for data management, data processing and related analysis.
2. Operation centre: Key aspects of this centre include responsibility for all non-critical data encompassing smart services/applications and basic ICT services.

[1] ITU-D SG2 Document SG2RGQ/70 from Egypt

Success case 8: Safety

The document from Japan[1] cited earlier concerns a safety-confirmation sensor that makes it possible to locate residents evacuated to community shelters in a disaster, register the number of people in each shelter and provide confirmation of their safety to their family and relatives, etc.

[1] ITU-D SG2 Document SG2RGQ/28+Annex from Japan

Success case 9: Safety

A document from the China International Telecommunication Construction Corporation (China)[1] introduces intelligent fire prevention. It provides a new way of thinking and a path to removing bottlenecks in fire safety. It involves the collection, transmission and processing of real-time, dynamic, interactive and integrated fire-protection information with the comprehensive use of GPS, geographic information systems (GIS) and building information modelling (BIM) technology, IoT, cloud computing and other new-generation information technologies, via the Internet, wireless communication networks, private networks and other communication networks, to intelligently perceive, identify, locate and track the status of firefighting facilities, equipment and personnel.

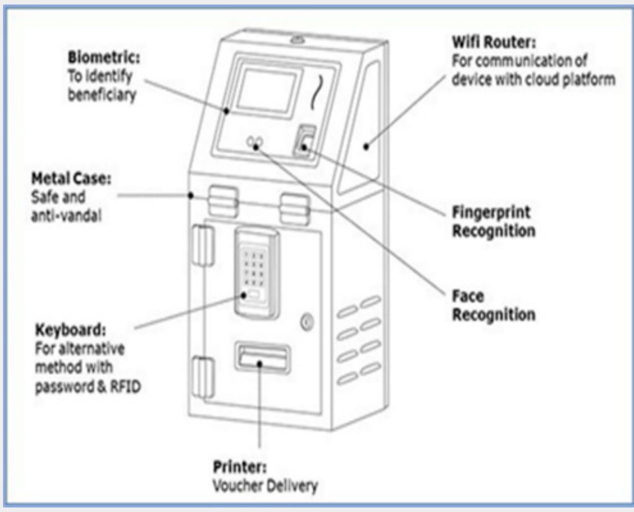
1 ITU-D SG2 Document 2/283 from CITCC (China)

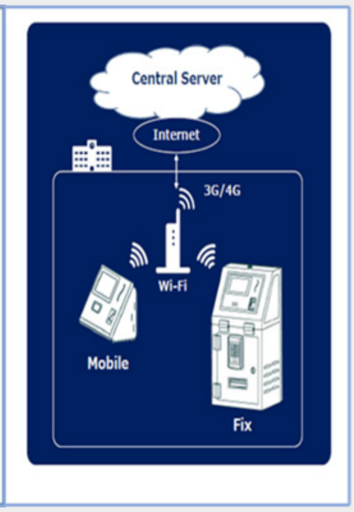
Success case 10: Digital government

A contribution from NEC corporation (Japan)[1] relates to a project at the National Board of School Aid and Scholarships (JUNAEB) in Chile that aims to promote the health of 1.6 million students attending 9 000 public schools by appropriately distributing meals corresponding to the income of the family. A solution was offered to set up biometric authentication equipment based on fingerprint and face recognition. The solution enabled JUNAEB to accurately verify and validate eligible recipients of meals, trace correct delivery of designated supplies, minimize waste, and monitor student nutritional intake. In this way, even the most vulnerable children in the country are able to securely and equitably receive meals that meet their nutritional needs.

This is a good example of digital government, one of whose missions is to provide public services in an efficient, secure and fair manner.

Biometric authentication terminal (left) and system in school unit (right)





1 ITU-D SG2 Document 2/207 from NEC Corporation (Japan)

Success case 11: Digital government

Contributions from India[1] describe how the vision of end-to-end electronic and online services is being realized in various domains, with platforms and applications created by the national government. These include the Aadhaar platform (a 12-digit government-issued unique identification number for every resident of India) for authenticating a person's identity, an Aadhaar authentication-based online e-Sign facility for digitally signing a document, a digital locker for storing and sharing electronic documents, the PayGov platform for online payments, and the Jan Dhan Yojana for direct transfer of benefits and payments to bank accounts.

The Government of India started the "Digital India" project in order to turn India into a digitally empowered society. At the core of several of its digitalization schemes is its biometric-based (fingerprints and iris) digital identification project called Aadhaar. This is the world's biggest identification project, which is extensively used by eligible citizens for various government services. The Aadhaar has helped India become a digitally empowered society. The Aadhaar number is a unique, non-duplicable and robust identity number which has given identity to Indian residents, particularly those who require assistance from government schemes and programmes. By putting in place a safe, secure, non-repudiable, non-duplicable and robust identity infrastructure, the benefits of government schemes are being transferred directly to the needy without involving middlemen. This has resulted in quick and honest delivery of services and help to the needy and has reduced corruption at the intermediate level significantly. The Aadhaar-enabled payment system has substantially increased digital transactions and has reduced the need to carry cash all the time.

[1] ITU-D SG2 Documents 2/72(Rev.1) and 2/209 from India

Success case 12: Digital government

A BDT document[1] describes the requirements of a national digital identity framework, which should ensure adequate safeguards for the privacy of users and guarantee an appropriate level of security for the information in order to gain a high level of trust among users and stakeholders. The implementation of robust and inclusive identification systems at the national level promises a considerable boost for the private sector, since the efficient, accurate and secure use of personal identity data is at the heart of most transactions.

A fundamental attribute of robust identification systems is the ability to establish not only the existence of individuals in a given jurisdiction, but also their uniqueness.

Essentially, three different models can be adopted for governing a national digital identity framework:

1. The government is directly involved as the identity provider.
2. The government acts as the regulator and is not involved as an identity provider.
3. The government acts as the regulator and identity broker/clearing house.

Various organizations have already tackled certain issues, producing a set of tools that can be very useful when designing and implementing a national digital identity framework.

Their number is quickly expanding, so the following list of the most relevant documents is not exhaustive.

- ISO/IEC standard 29115, "Information technology – Security techniques – Entity authentication assurance framework", a working framework for managing entity authentication assurance in a given context
- ISO/IEC standard 24760-1, "Information technology – Security techniques – A framework for identity management"
- Recommendation ITU-T X.1253, on proposed security guidelines for identity management systems.

[1] ITU-D SG2 Document SG2RGQ/56+Annex from the BDT Focal Point for Question 1/2

Success case 13: Digital government

Another contribution[1] features some of the main highlights from the GMIS-UNIDO-ITU special session held on 1 October 2018 on "Technologies and innovations for sustainable smart cities and societies". Four panellists (State of Geneva, KT Corporation, IBM, SmartUse) were present to provide their views on these questions and report on their activities.

[1] ITU-D SG2 Document SG2RGQ/TD/2 from the Co-Rapporteurs for Question 1/2

Success case 14: Smart transportation

The document from NEC Corporation (Japan)[1] cited above discusses the use of ICTs in an intelligent transport system (ITS). Traffic control is optimized for efficient transportation by adding IoT sensors and AI technology to the surveillance camera systems of the existing ITS. The first step is traffic counting. It is possible to visualize the traffic situation by measuring traffic flow using information obtained by IoT sensors and surveillance cameras. Image analysis is the key technology here. The most important item of information is the number of people actually in transit, rather than the number of vehicles, so AI systems count the number of passengers in each vehicle. The traffic-flow data obtained feeds into big data and AI processing, which make it possible to proceed to the second step, determining the cause of congestion, and then the third, making predictions about traffic demand and congestion. In the fourth step, traffic flow is dispersed, on the basis of the predictions, leading to optimization of traffic control. Predictions are also used for long-term city planning.

The objects of ICT systems using surveillance cameras, IoT sensors and AI technologies in traffic congestion measures are vehicles on the road and freeway. A similar ICT system can be used for motorcycles and bicycles in town, and even pedestrians in shopping areas, stations, stadiums and tourist spots, making it possible to visualize mobility, analyse the causes of and predict congestion, and optimize mobility for the purpose of easing congestion.

In addition, advanced behaviour detection technology can flag suspicious behaviour such as prohibited passengers on a motorcycle, and it will contribute to preventing accidents and crimes. ICTs utilized for smart transportation will offer society the benefits of not only greater efficiency but also improved safety and security.

1 ITU-D SG2 Document SG2RGQ/73 from NEC Corporation (Japan)

Success case 15: Smart transportation

Another document from NEC Corporation (Japan)[1] discusses the importance of open, real-time data for passengers and operators of public transportation with a use case for the Bus Rapid Transit System (BRT) in Ahmedabad, India.

Smart transportation uses advanced public transportation technology and systems for better public services. It can improve passenger experience, service performance, safety and equality of access (or ease of access for all) to transportation. Governments cannot force people to adopt public transportation, but only encourage them. Better-informed citizens make better decisions about their travel and priorities (e.g. safety, travel time and cost). A better passenger experience encourages people to choose public transport rather than private transport (e.g. cars), which can help cities achieve targets for reducing congestion and pollution. In particular, to encourage all segments of society (including all genders and all ages) to use public transportation services, these services must be safe. Open data is a key driver for developing safe, trusted public transportation services.

BRT, with the help of advanced ICT technologies, improves the efficiency and effectiveness of bus services by providing seamless, fast, reliable, safe and convenient public transportation. Smart City Ahmedabad Development Limited (SCADL) partnered with NEC to upgrade the city's manually operated, often erratic bus transit infrastructure with a data-centric, seamless and reliable intelligent transport management system. Ahmedabad is a good use case because its systems and services have open data at the heart of their planning, deployment and delivery, with real-time data being distributed to passengers and operators for the first time.

In addition to the problem of overcrowding, a number of problems were identified, as follows:

- irregular arrival and departure times, eroding trust in the bus service;
- a lack of estimated time of arrival (ETA) information at bus stops or stations;
- driver behaviour problems such as extreme braking, speeding and stop skipping;
- bunching and gapping of the headways (i.e. the spacing) of buses;
- slow, manual ticketing operations which may lead to cash-collection errors and delays.

These problems are typically a cause of an unsatisfactory passenger experience, by creating excess waiting time through inefficiency, discomfort during the ride, and safety concerns especially for women and children.

A smartphone application, with a journey planning feature, enables passengers to obtain real-time information about bus services. ETA information on mobile handsets and station displays has improved the passenger experience for all segments of passengers. Inside buses, the mobile application enables passengers to send alerts to the control centre to address emergency cases, or post grievances to address operational concerns.

These measures have given women safer access to public transportation because the introduction of real-time passenger information systems (PIS), delivering real-time ETA, has reduced excessive waiting times at bus stops. In the longer term, based on planning analysis using the scheduling system and the business intelligence tools, operation of the bus service has improved, by reducing non-revenue operation distances and providing better services to higher-demand trips (e.g. provide a higher frequency of service on routes with higher demand).

[1] ITU-D SG2 Document SG2RGQ/186 from NEC Corporation (Japan)

Success case 16: Smart transportation

A document from the Russian Federation[1] contains up-to-date information on the implementation of the intelligent transportation system (ITS) segment of the Russian Federation's smart-city project. ITSs are being developed primarily in central Russia. In Moscow, for example, such systems help to reduce traffic congestion, optimize public transport routes, provide drivers and passengers with live road traffic information, and so on. On the federal highways, ITSs are, as a rule, being introduced on high-speed toll roads with the objective, *inter alia*, of improving road safety and reducing the operational costs of road maintenance.

The smart-city ecosystem also encompasses solutions for the collection and processing of data on modes of transport and road infrastructure in order to facilitate decision-making. These include:

- traffic-flow sensors;
- adaptive (smart) traffic lights;
- automatic road traffic violation detectors;
- electronic means of non-stop toll collection;
- parking meters;
- connected information displays;
- automated lighting control systems;
- other connected objects (e.g. automatic road weather stations, road controllers, etc.);
- GPS/GLONASS systems.

As a rule, all Smart Road components are combined in a single platform. Even in isolation, however, they can help to resolve many local problems. The signals of traffic lights at intersections, for example, can change based on the live road-traffic situation, thereby improving roads' throughput and reducing the risk of congestion. Automatic road traffic violation detectors force drivers to be more responsible and, in turn, reduce the likelihood of accidents. The intelligent management of street lighting helps to reduce power consumption.

At present, the ITS includes automated components of a road traffic management system, an automated traffic control device management system, an automated traffic-flow parameter monitoring system, automated road-user information systems, an automated system for photographic and video recording of road traffic violations, an automated video monitoring system, and an automated dispatch and control system for ground-based urban passenger transport.

The importance of the development of an ITS is evident not only from the ever-rising numbers of automobiles on city roads and the emergence of problems caused by congestion. The main challenge driving the development of the ITS is the need to ensure safe and comfortable road travel for all users with the introduction of innovative technologies and new management solutions.

As a result of work carried out by the Road Traffic Management Centre, the ITS already boasts over 2 600 sets of operational traffic lights (intersections) which can be set to adaptive management mode. For monitoring and analysis of the situation on Moscow's roads, more than 2 000 video cameras and 3 700 sensors have been installed. The City of Moscow ITS is managed from the Situation Centre, which is ranked as the most modern in Europe.

[1] ITU-D SG2 Document 2/266 from the Russian Federation

Success case 17: Energy

A document from Japan[1] cited earlier describes a project of the city of Shiojiri to create an independent municipal electricity network to meet the needs of households and ICT networks in the region. The city has invested in a biomass energy production plant, which provides the 67 000 inhabitants of the region with inexpensive, environmentally friendly electricity with a zero-carbon footprint. This plant will contribute, on the one hand, to the socio-economic development of the region in the timber and logging sectors, as well as related sectors, and, on the other hand, to job creation for 400 people in local employment.

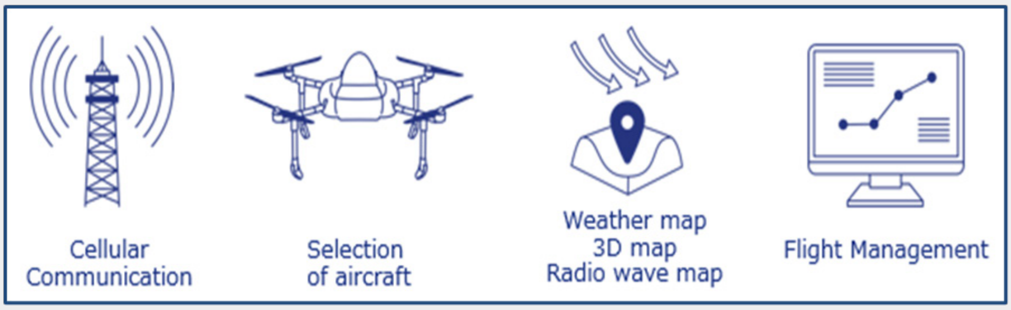
A sustainable smart city requires centralized information management, such as sensor systems, but even more important is the continuous supply of electricity. Sustained power cannot be supplied with solar panels alone. Forests occupy 80 per cent of Shiojiri, making them suitable for biomass power generation to provide sustained electricity. The biomass power plant contributed to establishing a regional industry chain from forestry and lumbering, and the production of wood chips to sustain an environment with forests and mountain ranges. For the two years to come, the power plant will come to supply 20 000 regional households for 24 hours. To avoid depletion of forest resources, forest management will address planning, logging, utilization and afforestation.

1 ITU-D SG2 Document SG2RGQ/28+Annex from Japan

Success case 18: Drones

A contribution from KDDI Corporation (Japan)[1] introduces the concept of a smart drone platform, integrating a variety of features such as the selection of aircraft, cellular communication capability and flight management capability. With cellular communication capability, the drone can be used wherever cellular communication coverage and cloud service become available. With flight management capability, the drone is monitored and controlled remotely from the platform dashboard, which also supports live video, weather map, 3D map and radiowave map.

Smart drone platform



The use cases described for the smart drone platform are tower inspection, wide area surveillance, long-distance logistics and stadium security.

Tower inspection by technicians involves risks associated with working at height. It is time-consuming and costly. Following the introduction of the smart drone platform, inspections that used to take about two hours, with a manual inspection involving four workers, will be reduced to one hour, involving two workers. Data management is also automated. The magnitude of the inspection task is thus reduced by a factor of four with respect to the manual inspection.

[1] ITU-D SG2 Document SG2RGQ/176(Rev.1) from KDDI Corporation (Japan)

Success case 19: Drones

A document from Shinshu University (Japan)[1] introduces the development of technology for combating pine wilt using drones.

Shinshu University is working together with Shiojiri City in Nagano Prefecture, Japan, to build a smart city.

They have been working in various ways to resolve regional issues with ICT. They describe the status of development of image-capturing technology and image-analysis technology, aimed at ascertaining the condition of pine wilt by taking a bird's-eye view from the air with a drone, so as to take pinpointed countermeasures.

Technology required for drone image analysis

1) Bird's-eye photography
   - Keep the distance from the subject being shot at regular intervals.
   - The image should be taken as a video.
   - Enable shooting over a long period.
2) Information processing after shooting
   - Create a bird's-eye view for the location from video.
   - Identify dead pine from still images by human work.
   - Identify dead pine by AI.
   - For the created file, specify the original in the blockchain.

A series of systems was built from drone bird's-eye photography to AI image determination.

As a result, the location of dead pine can be identified, and measures to prevent further spread can be taken at an early stage.

In addition, visual inspections have made it possible to measure cracks and other deterioration in the condition of bridges and other structures, giving a picture of the state of inaccessible portions of structures.

Surveys of disaster recovery following landslides have made it possible to develop proactive measures for landslide incidents.

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1 ITU-D SG2 Document SG2RGQ/173 from Shinshu University (Japan)

Success case 20: Open-source software

A document from the China International Telecommunication Construction Corporation (China)[1] shows that data fragmentation has become one of the major challenges for building smart cities in China. The key to smart cities is data sharing and openness. The existence of a large number of partitions between information has caused sets of data to be isolated within the different departments and sectors. As a result, data sharing and flow are hampered, the benefits of data resources cannot be realized, and the value of the data is difficult to assess.

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1 ITU-D SG2 Document 2/52 from CITCC (China)

Success case 21: Open-source software

Documents from NEC Corporation (Japan)[1]introduce some of the challenges experienced in Shiojiri City (Japan), where information is shared with the community via the city's information communication infrastructure (CATV) using software-defined networking (SDN) and data-utilization software (e.g. FIWARE).

SDN, the new concept for dynamically controlling a network and its architecture with software, separates network control from data transfer processing and dynamically controls devices that only perform data transfer processing with software. CATV operators play an important role as providers of information services for local and regional residents and communities. The use cases illustrate that SDN is applicable to CATV, and shows how SDN (which does not separate radio broadcasting and wired communication and adopts bidirectional communication) is one of the options that developing countries have when planning and deploying communication infrastructure.

Various environmental data can be collected by IoT sensors, but it is necessary to prepare a database of each sensor type. When building new environmental sensor networks for smart society, rather than separately collecting and managing databases divided into categories as in the past, it is possible to manage the task with data-utilization software (e.g. FIWARE).

In Shiojiri City, fruit-tree cultivation has been popular since ancient times, but farmers have been plagued by frost damage for many years. Now, data-utilization software is being used for predicting frost, rather than relying purely on experience and intuition as in the past, and to carry out quantified hazard monitoring and issue warnings. In addition, the CATV network's use of SDN makes it possible to guarantee the delivery of frost warnings to farmers. In the study, all frost warnings, using the SDN reserved bandwidth, were confirmed as delivered to the farmers. Farmers thus received frost warning in real time and were able to prevent damage and loss by taking measures to protect their crops against the frost episode. Effectively minimizing frost damage on fruit trees is of considerable benefit to producers. This service led to other solutions for regional problems in local industry. Information is used to deliver services such as disaster prevention, crime prevention, tourism, agricultural support, etc. to the local community via the information communication infrastructure (SDN).

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1 ITU-D SG2 Documents 2/208 and SG2RGQ/187 from NEC Corporation (Japan)

Success case 22: Open-source software - Smart city platforms in the Republic of Korea

A document from the Republic of Korea[1] introduces the smart-city strategy, which considers the smart city as a platform that connects urban resources, data and services rather than as a product. It summarizes the experience and lessons learned by the Government of the Republic of Korea in developing the smart-city platform.

The document reveals the important role that platforms play for smart cities. By providing the common base necessary for smart-city services, they facilitate service development and urban innovations. Without platforms, a smart city needs to create infrastructures service by service, which increases the cost and time needed to develop smart services. Furthermore, if services are developed and operated on different bases, it becomes difficult to link them.

To make data freely available in smart cities, Busan pilot city is creating an open data platform. The most important thing is to develop a platform of platforms. There are already many platforms for sharing data in smart cities. As a result, real cities are expected to use a variety of platforms to meet a variety of needs, rather than a single data platform. In this situation, in order for service developers to easily find and use data, they need a higher platform to connect their existing data platforms. Busan pilot city does not designate a specific data platform, but tries to support the utilization of data by creating a higher platform to connect the platforms.

The most important thing in developing a platform of platforms is to create data-standard models. Until now, data sharing has been used as a way of linking application systems, but it is hard to link many kinds of data that way. Therefore, it is necessary to make the best use of the international standards already established, to define data standards by sector and support the distribution and convergence of data. In addition, Busan pilot city focuses on linking, rather than collecting, data. It aims to break away from the traditional approach of creating a centralized data store for smart cities and establish a new way for distributed or decentralized data sharing.

[1] ITU-D SG2 Document 2/343 from the Republic of Korea

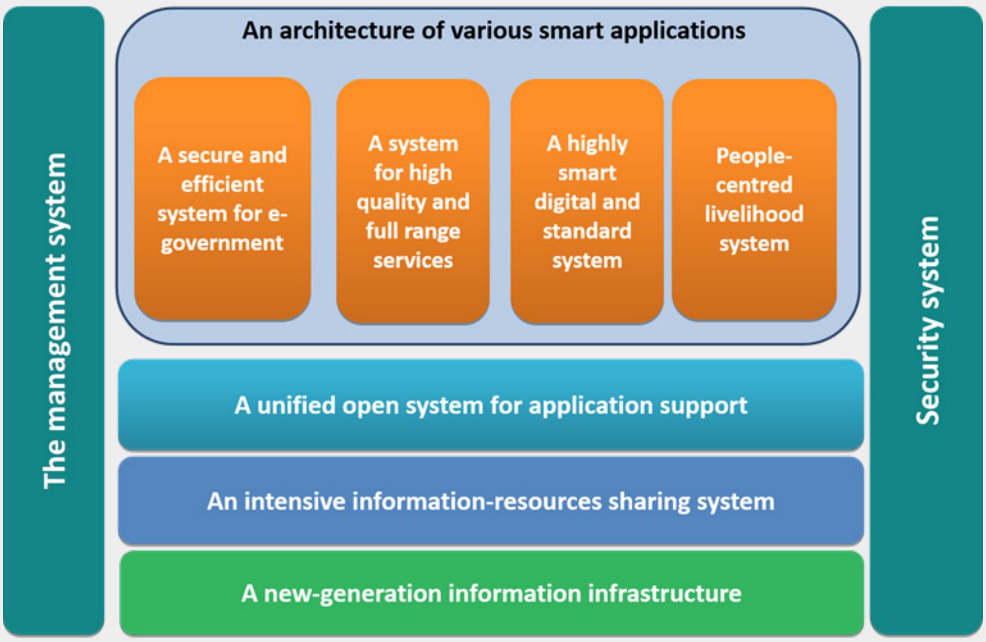
Success case 23: Smart parks

A document from China[1] deals with smart parks, constructed with modern ICTs such as cloud computing, IoT, mobile Internet, etc. to enable collaborative work, integrated logistics, services for mass entrepreneurship and innovation, and virtualized operation. The objective is to implement digitalized management and monitoring over the park area so that administrators can provide people-oriented services to businesses and residents in the park.

The aim of developing new types of smart parks is to achieve greater efficiency, collaboration, interaction and production for the entire park by integrating the businesses and residents into a closely-linked whole. To that end, an integrated routine operation and emergency response system needs to be established so that residents, vehicles and the flow of funds and materials within the park area can be tracked and controlled in an agile manner for the purpose of supporting businesses in their activities related to innovation, R&D and design, production and operation and management. Moreover, a unified platform will be put into place for coordination, business support and operation, thus making the park function in a smart and smoother manner as well as making life easier and more convenient for the residents.

Taking into account the above-mentioned aim and the increasingly diversified needs of the smart-park industry in China, a proposal was put forward for smart-park planning and design, as shown in the following diagram:

Overall architecture of the smart park



[1] ITU-D SG2 Document 2/55 from China

Success case 24: Smartphone safety classes at school

A document contributed by KDDI Corporation (Japan)[1] describes smartphone safety classes for schools. Since the launch of the programme in 2005, a total of 29 000 classes have been held with over 5 310 000 attendees. There is a wide variety of human rights-related risks on the Internet. Care is needed to avoid risks related to human rights in using the Internet, specifically: not to spread misinformation, write hurtful comments on social media, post identifiable information, too easily trust people met online and so on. In addition to those topics, students are trained to safely use information technology without endangering their human rights.

Feedback from the students, parents and teachers who participated in the safety classes includes reactions such as "I realized that a mental scar would last a lifetime if I misused the Internet", "I would like to make use of this learning to become a person who does not depend on games and the Internet", "I want to be careful while using it", "The classroom was perfect for students who are often hooked on smartphones" and "This is something parents should know".

In Japan, as smartphone use among school students has grown, so has the number of cases in which students have had harmful experiences, which can take many different forms. The demand for such safety classes, from teachers and parents, is increasing year by year. In these circumstances, the necessity and importance of educational activities to enhance IT literacy by measures such as smartphone safety classes are self-evident. These educational activities are intended to contribute to a safe and secure society where people do not suffer adverse effects from information and communication services such as smartphones and the Internet.

1 ITU-D SG2 Document 2/320 from KDDI Corporation (Japan)

Success case 25: Brazilian Charter for Smart Cities

A document from Brazil[1] presents the Brazilian Charter for Smart Cities published in December 2020, which is an initiative of the Ministry of Regional Development, in partnership with other ministries. It represents a collective effort to build a national strategy for smart cities, for the main purpose of supporting the promotion of sustainable urban development patterns, taking into account the Brazilian context of digital transformation in its cities.

1 ITU-D SG2 Document 2/405 from Brazil

Success case 26: Malaysia - 5G for smart applications in Langkawi Island

A document from Intel[1] highlights that small islands can also distribute existing submarine cable capacity with 5G networks inside the islands, for digital equity and economy. As a case study, Intel's contribution introduces the Malaysian Government's 5G smart applications in Langkawi Island, including traffic lights, parking, virtual reality, tourism, retail, utilities, agriculture and public safety. In January 2020, the Prime Minister launched a 5G Demonstration Project (5GDP) undertaken by the Malaysian Communications and Multimedia Commission (MCMC) in Langkawi to test and develop 5G applications further.

[1] ITU-D SG2 Document 2/416+Annexes from Intel Corporation (United States)

Annex 2: List of contributions and liaison statements received on Question 1/2

Contributions on Question 1/2

Web	Received	Source	Title
2/416 +Annexes	2021-03-09	Intel Corporation (United States)	Importance of Terrestrial High-Speed and High-Quality Broadband for Digital Equity
2/405	2021-03-02	Brazil	Brazilian Charter for Smart Cities
2/387 (Rev.1)	2021-01-28	Republic of Korea	Study topics for Question 1/2 for the next study period
2/367	2021-01-26	BDT Focal Point for Question 1/2	Development of digital government strategies and enterprise architecture for resource-constrained countries
RGQ2/273	2020-09-22	Brazil	Contributions to the Draft Output Report for Question 1/2
RGQ2/271 +Ann.1	2020-09-22	BDT Focal Point for Question 1/2	Accelerating digitalization of government services in low-resource settings
RGQ2/250 (Rev.1)	2020-09-08	Intel Corporation (United States)	Updated Information on the Global Status of 5G
RGQ2/243	2020-09-01	KDDI Corporation (Japan)	Location big data analysis by local governments nationwide for COVID-19 measures
RGQ2/231 (Rev.1)	2020-08-10	China	Take advantage of smart cities to meet the challenges of the COVID-19 pandemic
RGQ2/230	2020-08-19	State of Palestine under Resolution 99 (Rev. Dubai, 2018)	National digital transformation strategy
RGQ2/226	2020-08-10	China	Characteristics and recommendations for the development of smart poles in the context of 5G roll-out
2/TD/30 +Ann.1	2020-02-25	Co-Rapporteurs for Question 1/2	Changes to text and conclusion of Question 1/2 annual deliverable for the period 2019-2020
2/343	2020-02-11	Republic of Korea	Smart city platforms of Korea
2/333	2020-02-11	Intel Corporation (United States)	Draft Chapters for 3.2.3 (Policy Approaches), 3.2.4 (Fostering investment; fostering innovation), 3.2.5 (Governance; capacity building and skills for smart society), 3.2.6 (Financing mechanisms; sustainable development)
2/330	2020-02-06	BDT Focal Point for Question 1/2	Concept for the establishment of an international Digital Council for Food and Agriculture
2/329	2020-02-10	Algérie Télécom SPA (Algeria)	Proposed text for Section 4.1 ("Smart services") of the Final Report of Q1/2

(continued)

Web	Received	Source	Title
2/320	2020-02-04	KDDI Corporation (Japan)	Smartphone safety classes at school
2/315	2020-02-04	Intel Corporation (United States)	Updated information on Wi-Fi 6 (IEEE 802.11ax)
2/314	2020-02-04	Intel Corporation (United States)	Updated information on the global status of 5G
2/283	2020-01-04	China International Telecommunication Construction Corporation (China)	Application of smart fire protection in risk prevention and control of urban residential quarters
2/280	2020-01-03	Niger	Feedback on experience, setting up smart villages, Phase 2
2/279	2020-01-03	China	Top-level design and construction & operation of smart cities in China
2/268	2019-12-30	State of Palestine under Resolution 99 (Rev. Dubai, 2018)	Digital transformation policy
2/266	2019-12-27	Russian Federation	Creating smart cities and intelligent transport systems in the Russian Federation
2/260	2019-12-24	Benin	Sèmè City: A smart city in Benin
RGQ2/TD/10	2019-09-27	Russian Federation	Building smart cities in the Russian Federation
RGQ2/195 +Ann.1	2019-09-24	Egypt	Smart street poles
RGQ2/193	2019-09-24	Egypt	Design concepts of optical distribution network for smart cities in Egypt
RGQ2/192	2019-09-24	Republic of Korea	Smart city laws in Korea
RGQ2/189	2019-09-24	BDT Focal Point for Question 1/2	Smart Villages project in Niger
RGQ2/188 (Rev.1)	2019-09-24	Japan	Proposal for case studies of e-education in rural areas through ordinary use of emergency telecommunication systems
RGQ2/187	2019-09-24	NEC Corporation (Japan)	Feasibility study result: sustainable smart society with information communication infrastructure and data utilization software
RGQ2/186	2019-09-24	NEC Corporation (Japan)	The role of open, real-time data in improving equality of access for smart transportation projects
RGQ2/185	2019-09-23	BDT Focal Point for Question 1/2	Report on ICT Innovation Week in America 2019 - Smart rural communities (Montevideo, 5-8 August 2019)

(continued)

Web	Received	Source	Title
RGQ2/184	2019-09-23	Co-Rapporteur for Question 1/2	14th Global Forum on Human Settlements held at the United Nations Conference Center in Addis Ababa (UNCC-AA) on 5-6 September 2019
RGQ2/178	2019-09-24	Kenya	The digital economy blueprint for Kenya
RGQ2/176 (Rev.1)	2019-09-20	KDDI Corporation (Japan)	Smart Drone Platform
RGQ2/173	2019-09-19	Shinshu University (Japan)	Development of technology to solve pine blight countermeasure problems using drones
RGQ2/172	2019-09-18	Algérie Télécom SPA (Algeria)	Representation of the smart city by the citizen: case of the Algiers Smart City project
RGQ2/166	2019-09-10	Kenya	Universal Service Fund - The Case of Kenya
RGQ2/165	2019-09-10	BDT Focal Point for Question 1/2	ITU regional week on Emerging Technologies for Sustainable Development and Digital Transformation in the Arab Region (26-29 August 2019)
RGQ2/164	2019-09-10	Intel Corporation (United States)	Socio-economic benefits of 5G services provided in mmWave Bands
RGQ2/162	2019-09-10	Intel Corporation (United States)	Updated global 5G status
RGQ2/161 +Ann.1	2019-09-09	Shinshu University (Japan)	Development of a capacity-building curriculum on ICT skills for elementary to senior high school students
RGQ2/154	2019-08-22	United States	Lessons from U.S. smart communities experiences - NTIA perspective
RGQ2/136	2019-07-31	Niger	Setting up smart villages - Niger's experience
RGQ2/127	2019-07-21	State of Palestine under Resolution 99 (Rev. Dubai, 2018)	Strategic framework for the transition to e-municipalities (2019-2023)
2/TD/14 +Ann.1	2019-03-19	ITU-T Study Group 13	Liaison statement from ITU-T SG13 to ITU-D SG1 and 2 for information on invitation to review Big Data Standardization Roadmap and provide missing or updated information
2/219	2019-03-11	Republic of Korea	Korea’s National Pilot Smart City: The Case of Busan Eco Delta City
2/211	2019-03-12	Intel Corporation (United States)	Importance of smart cities, 5G, IoT and AI
2/209	2019-03-12	India	Positive impacts of the digitization process in India

(continued)

Web	Received	Source	Title
2/208	2019-03-12	NEC Corporation (Japan)	Sustainable smart society with information communication infrastructure and data utilization software
2/207	2019-03-12	NEC Corporation (Japan)	Biometric identification solution for school meal program in Chile
2/204	2019-03-11	Mali	Initiative ville intelligente au Mali
2/200	2019-03-08	BDT Focal Point for Question 1/2	Report on FAO-ITU E-agriculture Solutions Forum 2018 (Nanjing, 15-17 November 2018)
2/198	2019-03-06	China	Building a smart city brain to help developing smart cities (society)
2/196	2019-03-04	Intel Corporation (United States)	Importance and evolution of Wi-Fi
2/195	2019-03-04	Intel Corporation (United States)	Transition to high-speed, high-quality mobile broadband networks (5G)
2/164	2019-02-06	Mexico	Users' perception and knowledge of the Internet of Things
2/146	2019-01-20	Sudan	Exploring Big Data for Sustainable Development Goals in Sudan
2/135	2019-01-11	Cameroon	Action taken by Cameroon towards the creation of the smart society
RGQ2/TD/2	2018-10-01	Co-Rapporteurs for Question 1/2	Highlights from GMIS-UNIDO-ITU special session panel 2 on technologies and innovations for sustainable smart cities and societies
RGQ2/73	2018-09-18	NEC Corporation (Japan)	Safety for smart cities and societies
RGQ2/70	2018-09-18	Egypt	Main architecture elements of a smart city
RGQ2/67	2018-09-17	Republic of Korea	Korea's smart city policy
RGQ2/63	2018-09-13	Hungary	Twinning of ICT centric innovation ecosystem good practices that accelerate digital development2
RGQ2/57 +Ann.1	2018-09-12	BDT Focal Point for Question 1/2	SDG Digital Investment Framework: a whole-of-government approach to investing in digital technologies to achieve the SDGs a global call to action for the UN General Assembly
RGQ2/56 +Ann.1	2018-09-12	BDT Focal Point for Question 1/2	Digital Identity Road Map Guide
RGQ2/54	2018-09-07	KDDI Corporation (Japan)	LTE Cat.M1, candidate for suitable telecommunication system in IoT era

(continued)

Web	Received	Source	Title
RGQ2/49	2018-09-03	BDT Focal Point for Question 1/1	m-Powering for Development 2018 report
RGQ2/48	2018-09-03	BDT Focal Point for Question 1/1	Setting the scene for 5G: Opportunities & Challenges
RGQ2/46 +Ann.1-6	2018-08-28	BDT Focal Point for Question 6/1	GSR 2018 Best Practice Guidelines
RGQ2/40 +Ann.1	2018-08-22	BDT Focal Point for Questions 1/1, 1/2, 2/1 and 7/2	Regional Seminar for Europe and CIS on "5G Implementation in Europe and CIS: Strategies and Policies Enabling New Growth Opportunities, Budapest July 2018
RGQ2/29 +Ann.1	2018-08-15	Daiwa Computer Co., Ltd. (Japan)	ICT-applied farming method for producing muskmelon by an IT company
RGQ2/28 +Ann.1	2018-08-15	Japan	Proposal for the sustainable smart society
RGQ2/24	2018-08-14	Benin	Start-ups as a motor of sustainable socio-economic development in the creation of smart cities and societies and e-health
RGQ2/19 +Ann.1	2018-08-08	Hungary	Report on the ITU-D Study Groups related Experts' Knowledge Exchange
2/TD/11	2018-05-11	Co-Rapporteur for Question 1/2	Draft work plan for Question 1/2
2/95	2018-04-26	BDT Focal Point for Question 1/2	Digital Identity for Development and Smart Society
2/89	2018-04-24	Democratic Republic of the Congo	Créer une société et des villes intelligentes
2/81	2018-04-20	China	Research on the development of a smart society and China's best practices
2/78	2018-04-17	Iran University of Science and Technology (Islamic Republic of Iran)	Smart school in the Islamic Republic of Iran
2/72 (Rev.1)	2018-04-12	India	Capacity building initiative for the rural/urban poor community towards successful implementation of ICT projects for developments of a smart society - a step towards sustainability
2/64	2018-04-06	Brazil	Topics for the study of Question 1/2 for the next study period
2/61 (Rev.1)	2018-03-26	BDT Focal Point for Question 3/1	Report on regional workshop on emerging technologies (Algiers, 14-15 February 2018)

(continued)

Web	Received	Source	Title
2/60	2018-03-23	Comoros	Mise en œuvre d'une démarche devant aboutir à une ville intelligente en Union des Comores
2/57	2018-03-22	Algérie Télécom SPA (Algeria)	Call for collaboration and partnerships for Smart city Algiers
2/55	2018-03-21	China	Studies on planning and design of smart parks
2/54	2018-03-21	China	Using NB-IOT technology to realize intelligent asset management and improve the level of urban management
2/53	2018-03-21	China	Construction and development of smart cities based on big data: an analysis
2/52	2018-03-21	China	An iterative construction concept based on "China's New Smart City Evaluation Index System"

Incoming liaison statements for Question 1/2

Web	Received	Source	Title
RGQ2/281	2020-09-22	ITU-T Study Group 15	Liaison statement from ITU-T SG15 to ITU-D SG1 and 2 on the new version of the Access Network Transport (ANT) and Home Network Transport (HNT) Standards Overviews and Work Plans
RGQ2/227 +Ann.1	2020-08-14	ITU-T Study Group 13	Liaison statement from ITU-T SG13 to ITU-D SG1 and SG2 on invitation to review Big Data Standardization Roadmap and provide missing or updated information
RGQ2/213	2020-07-22	ITU-T Study Group 20	Liaison statement from ITU-T SG20 to ITU-D SG2 Q1/2 on Impact of IoT and Sensing Technologies
RGQ2/202	2020-02-18	ITU-T Study Group 15	Liaison statement from ITU-T SG15 to ITU-D SG1 and SG2 on the new version of the Access Network Transport (ANT) and Home Network Transport (HNT) Standards Overviews and Work Plans
2/258	2019-12-20	ITU-T FG-AI4EE	Liaison statement from ITU-T FG-AI4EE to ITU-D Study Group 1 and 2 on the first meeting of ITU-T Focus Group on Environmental Efficiency for Artificial Intelligence and Other Emerging Technologies
2/246 +Ann.1	2019-10-30	ITU-T Study Group 13	Liaison statement from ITU-T SG13 to ITU-D Study Group 1 and 2 on invitation to review Big Data Standardization Roadmap and provide missing or updated information
2/244	2019-10-30	JCA-IMT2020	Liaison statement from ITU-T JCA IMT2020 to ITU-D Study Group 1 and 2 on invitation to update the information in the IMT2020 roadmap
RGQ2/130 +Ann.1	2019-07-22	ITU-T Study Group 15	Liaison statement from ITU-T SG15 to ITU-D SG1 and SG2 on inter-Sector coordination
RGQ2/129	2019-07-22	ITU-T Study Group 15	Liaison statement from ITU-T SG15 to ITU-D SG1 and SG2 on the new version of the Access Network Transport (ANT), Smart Grid and Home Network Transport (HNT) Standards Overviews and Work Plans
RGQ2/124 (Rev.1)	2019-07-18	ITU-R study groups - ITU-R Working Party 4A	Liaison statement from ITU-R WP4B to ITU-D SG1 and SG2 on interrelated activities of ITU-R and ITU-D in response to Resolution ITU-R 69 (RA-15)
RGQ2/120	2019-07-09	ITU-R study groups - ITU-R Working Party 4B	Liaison statement from ITU-R WP4B to ITU-D SG1 and SG2 on interrelated activities of ITU-R and ITU-D in response to Resolution ITU-R 69 (RA-15)

(continued)

Web	Received	Source	Title
RGQ2/116 +Ann.1-2	2019-05-29	ITU-T Study Group 20	Liaison statement from ITU-T SG20 to ITU-D SG1 and SG2 on ITU inter-sector coordination
RGQ2/114 +Ann.1-2	2019-06-12	ITU-T Study Group 5	Liaison statement from ITU-T SG5 to ITU-D SG1 and SG2 on ITU inter-sector coordination
RGQ2/108	2019-07-05	ITU-T JCA-IMT2020	Liaison statement from ITU-T JCA-IMT2020 to ITU-D study groups with invitation to update the information in the IMT2020 roadmap
2/132 +Ann.1	2019-01-08	JCA-IoT and SC&C	Liaison statement from ITU-T JCA-IoT and SC&C to ITU-D SG2 Q1/2 on request to update the IoT and SC&C Standards Roadmap and the list of contact points
2/129 +Ann.1	2018-12-21	JCA-IoT and SC&C	Liaison statement from ITU-T JCA-IoT and SC&C to ITU-D SG2 Q1/2 on presentation on the activities carried out by the Ministry of Telecommunications and Information Society, Ecuador (MINTEL) on smart cities
2/128	2018-12-21	JCA-IoT and SC&C	Liaison statement from ITU-T JCA-IoT and SC&C to ITU-D SG2 Q1/2 on Global Portal on Internet of Things and Smart Sustainable Cities
RGQ2/44 +Ann.1	2018-08-27	ITU-T Study Group 13	Liaison statement from ITU-T SG13 to ITU-D SG1 Q3/1 on and ITU-D SG2 Q1/2 on invitation to review Big Data Standardization Roadmap and provide missing or updated information
RGQ2/14 +Ann.1	2018-07-18	ITU-R study groups - Working Party 4A	Liaison statement from the ITU-R WP 4A to ITU-D Study Group 1 and 2 on interrelated activities of ITU-R and ITU-D in response to Resolution ITU-R 69 (RA-15)
RGQ2/10	2018-07-17	ITU-R study groups - Working Party 4B	Liaison statement from ITU-R WP 4B to ITU-D SG1 Q1/1 and Q2/1 and SG2 Q1/2 and Q5/2 on interrelated activities of ITU-R and ITU-D in response to Resolution ITU-R 69 (RA-15)
RGQ2/4	2018-05-30	ITU-T JCA-IoT and SC&C	Liaison Statement from JCA-IoT and SC&C to ITU-D SG2 on requesting to appoint a liaison representative from ITU-D SG2
RGQ2/3	2018-05-11	ITU-T JCA-IMT2020	Liaison Statement from JCA-IMT2020 to ITU-D Study Groups 1 and 2 on invitation to update the information in the IMT2020 roadmap
2/46	2018-03-05	ITU-T JCA-IMT2020	Liaison Statement from ITU-T JCA-IMT2020 to ITU-D study groups on invitation to update the information in the IMT2020 roadmap

(continued)

Web	Received	Source	Title
2/40	2018-02-26	ITU-T Study Group 15	Liaison Statement to ITU-D study groups from ITU-T SG15 on ITU inter-Sector coordination on lead study group activities
2/39 (Rev.1)	2018-02-26	ITU-T Study Group 15	Liaison Statement to ITU-D study groups from ITU-T SG15 regarding contributions from developing countries addressed to ITU-T SG15
2/24	2017-11-24	ITU-T Study Group 20	Liaison Statement from ITU-T SG20 to ITU-D SG2 Question 1/2 on Final Report for ITU-D SG2 Q1/2 (smart society)
2/19	2017-11-22	ITU-T JCA-MMeS	Liaison Statement from ITU-T JCA-MMeS to ITU-D study groups on the amendment of the Terms of Reference of the JCA on multimedia aspects of e-services
2/18	2017-11-22	ITU-T Focus Group on DPM	Liaison Statement from ITU-T FG-DPM to ITU-D study groups on the first meeting of ITU-T Focus Group on Data Processing and Management to support IoT and Smart Cities & Communities (FG-DPM)

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