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| ITU‑T Study Group 20Internet of things (IoT) and smart cities and communities (SC&C) |
| Report of ITU-T SG20 to the World Telecommunication Standardization Assembly (WTSA-24), Part II: Questions proposed for study during the next study period (2025-2028) |
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| **Abstract:** | This contribution contains the text of the Study Group 20 Questions proposed for approval by the Assembly for the 2025-2028 study period. |
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Note by the TSB:

The report of Study Group 20 to the WTSA-24 is presented in the following documents:

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# 1 List of Questions proposed by Study Group 20

| Question number | Question title | Status |
| --- | --- | --- |
| A/20 | Requirements, capabilities and architectural frameworks of IoT and SSC&C across verticals | Continuation of Q2/20 |
| B/20 | Human-centric digital services enabled by IoT and SSC&C related to digital health, accessibility and inclusion | New |
| C/20 | Security, privacy, trustworthiness, and identification of IoT and SSC&C | Continuation of Q6/20 |
| D/20 | Data analytics, sharing, processing and management, including big data aspects, of IoT and SSC&C | Continuation of Q4/20 |
| E/20 | Decentralized/distributed IoT | New |
| F/20 | Architectures, functionalities, and protocols in applications of verticals and infrastructures of IoT and SSC&C | Continuation of Q3/20 |
| G/20 | Evaluation and assessment of smart sustainable cities and communities and digital services | Continuation of Q7/20 |
| H/20 | Interworking between smart city platforms including digital twins | Continuation of Q1/20 |
| I/20 | Terminology and definitions, study and research of emerging digital technologies | Continuation of Q5/20 |

# 2 Wording of Questions

## DRAFT QUESTION A/20Requirements, capabilities and architectural frameworks of IoT and SSC&C across verticals

(Continuation of Question 2/20)

### A.1 Motivation

SG20 focuses on the framework and roadmaps for the harmonized and coordinated development of the Internet of things (IoT), including machine-to-machine (M2M) communications ubiquitous sensor networks, and relevant emerging technologies, like edge computing, artificial intelligence (AI), machine learning (ML), blockchain, digital twins, metaverse, data processing and analytics, orchestration and automation technologies, advanced sensing and actuation technologies, among others. In addition, it develops guidelines, methodologies and best practices related to standards to help cities, communities, and rural areas deliver services using relevant emerging technologies, also known as smart sustainable cities and communities (SSC&C).

As the number of services and applications of the IoT increase, it is useful to understand common requirements, capabilities, and architectural frameworks of IoT and how relevant emerging technologies might be used to support IoT development. It could be argued that common capabilities and architectural frameworks of IoT - across different verticals - could assist in making these technologies more cost-efficient, competitive, and more-easily deployed. In addition, it is important to better understand the way in which relevant standards in this space interact with practical aspects of implementation, deployment, operation and maintenance of IoT. Similarly, given the diverse uses and types of technologies for municipal governments to create SSC&C, it is useful to understand their common requirements, capabilities, and architectural frameworks. Of particular interest is how relevant emerging technologies (see the list above) might be used to provide more-efficient, and more-easily deployed digital services. In addition, it is important to better understand the way in which relevant standards in this space interact with practical aspects of implementation, deployment, operation and maintenance of SSC&C. This Question addresses the common and specific requirements, capabilities, use cases and architectural frameworks of IoT and SSC&C enhanced by emerging technologies across verticals.

### A.2 Question

Study items include, but are not limited to:

– What are the use cases of IoT and SSC&C across different verticals, excluding human-centric IoT and SSC&C services and applications related to digital health, accessibility and inclusion?

– What are the requirements, capabilities and architectural frameworks of IoT and SSC&C across different verticals, excluding human-centric IoT and SSC&C services and applications related to digital health, accessibility and inclusion?

– With which standards development organizations (SDOs) collaboration would be necessary to maximize synergies and harmonize existing standards?

### A.3 Tasks

Tasks include, but are not limited to:

– Developing Recommendations, Reports, roadmaps, guidelines etc. as appropriate for the support of emerging services and applications for IoT and SSC&C, covering:

 use cases of IoT and SSC&C across different verticals, excluding human-centric IoT and SSC&C services and applications related to digital health, accessibility and inclusion;

 common and specific requirements, capabilities and architectural frameworks of IoT and SSC&C across different verticals, excluding human-centric IoT and SSC&C services and applications related to digital health, accessibility and inclusion; and

 related implementation, deployment, operation and maintenance of IoT and SSC&C with respect to the above tasks.

– Providing the necessary analysis of and collaboration for joint activities in this field within ITU and between ITU-T and other relevant SDOs, consortia and forums.

An up-to-date status of work under this Question is contained in the SG20 work programme ([https://itu.int/ITU-T/workprog/wp\_search.aspx?sg=20](https://www.itu.int/ITU-T/workprog/wp_search.aspx?sg=20)).

### A.4 Relationships

Recommendations:

– Y.4000-series including Y.4000, Y.4003, Y.4100, Y.4101, Y.4102, Y.4103/F.748.0, Y.4105, Y.4108, Y.4109, Y.4111, Y.4112, Y.4113, Y.4116, Y.4117, Y.4118, Y.4119, Y.4120, Y.4121, Y.4122, Y.4123, Y.4202, Y.4203, Y.4206, Y.4207, Y.4208, Y.4209, Y.4210, Y.4212, Y.4213, Y.4214, Y.4215, Y.4217, Y.4218, Y.4220, Y.4223, Y.4225, Y.4250, Y.4401, Y.4419, Y.4457, Y.4464, Y.4481, Y.4482, Y.4490, Y.4552, Y.4601, Y.4702

Questions:

– All Questions of ITU-T SG20

Study groups:

– ITU-T (e.g., considering their lead study group role), ITU-D and ITU-R study groups, as appropriate

Other bodies:

– IETF

– Open Mobile Alliance (OMA)

– Open Geospatial Consortium (OGC)

– IEEE

– ATIS

– ETSI TC Smart M2M

– CCSA TC10

– oneM2M

– ISO/IEC JTC 1/SC41, ISO/IEC JTC 1/WG11

– Joint IEC-ISO-ITU Smart Cities Task Force

– GSMA

– 3GPP

– W3C

– Open & Agile Smart Cities (OASC)

– Object Management Group (OMG)

– Alliance of Industrial Internet (AII)

– Alliance for IoT and Edge Computing Innovation (AIOTI)

– Open Connectivity Foundation (OCF)

– 5G Alliances (e.g., 5G AA, 5G ACIA, etc.)

WSIS Action Lines:

– C2, C3, C5, C6, C7, C8, C10

Sustainable Development Goals:

– SDGs 9, 10 and 11

## DRAFT QUESTION B/20Human-centric digital services enabled by IoT and SSC&C related to digital health, accessibility and inclusion

(New Question)

### B.1 Motivation

The Internet of things (IoT) and smart sustainable cities and communities (SSC&C) offer numerous technological possibilities to enhance the quality of human life. To fully realize these benefits, it is crucial to adopt a human-centred approach in the design and operation of digital services. This requires communicating with people to understand their needs and then using technology to address them. Especially in SSC&C, technical innovations can indeed optimize certain aspects of urban life, but these must be paired with a better understanding of humans.

The human-centric approach has focused on retrofitting to rectify the lack of consideration for humans' interest in adopting technologies. Many standardization activities and academic research have secured the core principles of a human-centric approach, including universal design, but they need implementation. Specific and practical requirements, capabilities, and use cases that can apply core principles of a human-centric approach to digital services enabled by IoT and SSC&C need to be studied.

One of the key areas of human-centric IoT and SSC&C applications and services is digital health, which improves healthy lives and promotes well-being for all. Digital health services using IoT and SSC&C technologies can significantly reduce healthcare costs and improve treatment outcomes. As an example, IoT can exert the potential to keep patients safe and healthy and allow doctors to provide the best treatment through remote monitoring, interaction with doctors, and patient participation in the medical field.

Another key area of human-centric IoT and SSC&C applications and services is accessibility and inclusion. Accessible digital services enabled by IoT and SSC&C aim to embrace all users, including persons with disabilities, persons with age-related disabilities and persons with specific needs. The final goal is to implement services that all humans, to the greatest extent possible, can access and that bridge the digital divide.

Furthermore, to achieve accessibility, we shall not exclude assistive devices for particular groups of persons with disabilities where this is needed. IoT and SSC&C applications and services can be used as assistive technology for persons with disabilities to enable, maintain, or improve their functional capabilities.

In summary, this Question will address the following key topics related to human-centric digital services enabled by IoT and SSC&C applications and services:

– digital health services enabled by IoT and SSC&C technologies,

– accessible and inclusive digital services enabled by IoT and SSC&C for all people, including persons with disabilities and older people,

– assistive IoT and SSC&C applications and services specifically designed for persons with disabilities and older people.

### B.2 Question

Study items include, but are not limited to:

– What are the requirements, capabilities, and use cases of human-centric digital services enabled by IoT and SSC&C?

– What are the requirements, capabilities, and use cases of digital health services enabled by IoT and SSC&C?

– What are the use cases addressing good practices of accessible and inclusive digital services enabled by IoT and SSC&C?

– What are the requirements for accessible and inclusive digital services enabled by IoT and SSC&C for all people, including persons with disabilities and older people?

– What are the requirements, capabilities, and use cases of assistive IoT and SSC&C applications and services that can help mitigate the difficulties of persons with disabilities and older people?

### B.3 Tasks

Tasks include, but are not limited to:

– Developing Recommendations, Supplements, Reports, guidelines, etc., as appropriate;

– Development of Recommendations pertaining to the study items above on human-centric digital services enabled by IoT and SSC&C as needed;

– Development of non-normative texts pertaining to the study items above on human-centric digital services enabled by IoT and SSC&C as needed;

– Maintenance of Recommendations and non-normative texts under the responsibility of the Question;

– Providing the necessary collaboration for joint activities within ITU and between ITU-T and other relevant SDOs, consortia and forums.

### B.4 Relationships

Recommendations:

– ITU-T Y-series Recommendations addressing digital health, accessibility and inclusion; including Y.4110, Y.4204, Y.4211, Y.4214, Y.4219, Y.4222, Y.4408, Y.4496

Questions:

– All Questions of SG20

Study groups:

– ITU-T [SG9 and SG16/SGC] on accessibility (in particular [Q11/9 and Q26/16| QAcc/C] on accessibility) and Q28/16 on digital health applications)

– ITU-D SG1 and SG2

Other bodies:

– ITU-T JCA-AHF

– ISO/IEC JTC1 SC35

– Open & Agile Smart Cities (OASC)

– W3C

– G3ict

WSIS Action Lines:

– C2, C3, C4, C6, C7, C8, C9, C10, C12

Sustainable Development Goals:

– SDGs 3, 4, 5, 9, 10, 11, 16

## DRAFT QUESTION C/20Security, privacy, trustworthiness, and identification of IoT and SSC&C

(Continuation of Question 6/20)

### C.1 Motivation

Towards the information society, there are increases in cyber-attacks, cybercrime, and loss of credit or trust. The information and communication technology (ICT) infrastructure will evolve to provide converged services and applications by accommodating a large number of Internet of things (IoT) sensors and IoT-related systems. Additionally, the world is experiencing an evolution of smart sustainable cities and communities (SSC&C). Many stakeholders from various industries are involved in future converged and intelligent services to be deployed in IoT and SSC&C using ICT infrastructure.

This heterogeneous environment, while it promises great advances in the way the services and applications are provisioned, and in the way systems are managed, administered, and maintained, yet comes with a very wide range of sector-specific risks and threat vectors. Implications for security, personal identifiable information (PII) protection, safety, and the overall trust of use, adoption, and proliferation of IoT and SSC&C data, devices, systems, services, applications, and platforms, could hinder the overall market development. Therefore, it is important that security, PII protection and privacy concerns are taken into account throughout the design process of products and systems to be used in IoT and SSC&C implementations. This is commonly known as safety and security by design, which emphasize that protection be built into information technologies, business practices, systems, processes, physical design, and networked infrastructure.

Various identification techniques have always been regarded as an important enabling technology for IoT and SSC&C implementation and interoperability. Both physical things (such as tagged items and products, sensing devices) and virtual things (such as computational processes, software) could have, or already have, assigned identifiers, in order to be identified and distinguished. It is important for each thing to be addressable, and identifiable.

Taking into account the variety of data, devices, systems, services and applications within heterogeneous IoT and SSC&C domains, it is essential to develop trustworthiness models that ensure all physical and virtual things involved are trusted enough to be part of IoT and SSC&C environment. Such models should be integrated within IoT and SSC&C architectures while defining the set of rules to ensure implementation of trusted IoT and SSC&C systems. The trustworthiness aspects should be substantial part of any end-to-end architectures developed for IoT and SSC&C verticals.

It is also essential to consider the security, safety, trustworthiness, interoperability for the human-oriented applications and services in IoT and SSC&C, such as digital services (e.g., electronic transaction services), metaverse, and public safety. The continuity, sustainability and robustness of those applications and services also should be considered carefully.

In addition, the adoption of emerging technologies such as blockchain, big data, quantum computing, artificial intelligence and machine learning can play an important role in developing advanced cost-effective measures and mechanisms to create such secured, safe and trustworthy environment within IoT and SSC&C domains.

All above requirements need to be carefully analysed for various IoT and SSC&C verticals that may require specific additional demands due to their nature and the underlying standards they use for IoT and SSC&C devices, systems, platforms, infrastructures, applications, and services.

### C.2 Question

Study items include, but are not limited to:

– What are the possible risks and threats against the compromise of authenticity, confidentiality, integrity, non-repudiation, availability, and portability of IoT and SSC&C data, devices, systems, platforms, infrastructures, applications, and services?

– What is needed to identify, mitigate and counteract the security risks and threats and protect data and PII in the context of IoT and SSC&C?

– What are the technical measures capable of fulfilling the requirements of IoT and SSC&C to improve the security, safety, trustworthiness, data and PII protection?

– What requirements and identification measures may be used for improving interoperability in IoT and SSC&C when appropriate?

– How can emerging technologies and mechanisms be used to improve security, safety, trustworthiness and to protect data and PII in IoT and SSC&C, including big data, blockchain, machine learning, artificial intelligence, quantum computing, zero trust?

– How to ensure security, safety and trustworthiness of digital services (including electronic transaction services) and metaverse in IoT and SSC&C?

– What are the requirements and associated technical measures to improve the security, reliability, continuity, sustainability and robustness of IoT and SSC&C applications and services for public safety?

– Which standards development organizations (SDOs), consortia and forums would it be necessary to collaborate with to maximize synergies and harmonize existing standards?

### C.3 Tasks

Tasks include, but are not limited to:

– Developing Recommendations, Reports, guidelines, etc., as appropriate, on:

 reliability, authenticity, confidentiality, integrity, non-repudiation, and availability of IoT and SSC&C data, devices, systems, infrastructures, platforms, applications and services;

 security requirements and associated technical measures to identify and mitigate security risks and threats and to protect data and PII in the context of IoT and SSC&C;

 requirements and technical measures to improve safety and trustworthiness in IoT and SSC&C data, devices, systems, platforms, infrastructures, applications and services;

 requirements and associated identification measures (such as naming, addressing, and identity discovery) to improve interoperability in IoT and SSC&C;

 emerging technologies and mechanisms to improve security, safety, trustworthiness and to protect data and PII in IoT and SSC&C, such as big data, blockchain, machine learning, artificial intelligence, quantum computing;

 security, safety, trustworthiness and PII protection, identification of digital services (e.g., electronic transaction services) and metaverse in IoT and SSC&C;

 security, reliability, continuity, sustainability and robustness of IoT and SSC&C applications and services for public safety.

– Collaboration as appropriate in these fields within ITU and between ITU-T and SDOs, consortia and forums.

An up-to-date status of work under this Question is found in the SG20 work programme (<https://itu.int/ITU-T/workprog/wp_search.aspx?sg=20>).

### C.4 Relationships

Recommendations:

– Y.4000-series and other Recommendations related to security, PII protection, safety, trust and identification

Questions:

– All Questions of ITU-T SG20

Study groups:

– ITU-T (e.g., considering their lead study group role), ITU-D and ITU-R study groups, as appropriate

– ITU-T SG2 and ITU-T SG17 on identification aspects of IoT and SSC&C, as per the mandate of each study group

– ITU-T SG17 on security, PII protection, safety and trustworthiness issues relating to IoT and SSC&C, as per the mandate of each study group

Other bodies:

– ETSI

– ENISA

– Alliance for IoT and Edge Computing Innovation (AIOTI)

– IEEE

– 3GPP

– W3C

– ISO/IEC JCT 1

– Joint IEC-ISO-ITU Smart Cities Task Force

– IETF

– Open & Agile Smart Cities (OASC)

– OASIS

– oneM2M

WSIS Action Lines:

– C5

Sustainable Development Goals:

– SDGs 11 and 17

## DRAFT QUESTION D/20Data analytics, sharing, processing and management, including big data aspects, of IoT and SSC&C

(Continuation of Question 4/20)

### D.1 Motivation

ITU-T Study Group 20 focuses on the framework and roadmaps for the harmonized and coordinated development of the Internet of things (IoT), machine-to-machine (M2M) communications, ubiquitous sensor networks, and relevant emerging technologies. In addition, it develops guidelines, methodologies and best practices related to standards to help cities, communities, and rural areas deliver services using relevant emerging technologies, also known as smart sustainable cities and communities (SSC&C).

While traditional information databases and analytics architectures and infrastructures remain essential, it is important to understand technical approaches to how IoT devices, platform and networks collect, process, manage, and present data from various sources. These aspects rely on both the specific capabilities/capacities of these approaches as well as general policy guidance in the data lifecycle.

Another topic of importance includes potential "imperfections" or risks in a given data processing and management (DPM) framework and how they affect the effectiveness of an IoT capability. Implementing feasible DPM guidelines and standards can make the collection, storage and retrieval of large amounts of data fast and cost-effective while addressing data complexities and governance, including dataspaces to overcome some of the problems encountered in data integration systems. There is also an interest in studying how data aspects of IoT services and applications are powered by emerging technologies (e.g., blockchain, artificial intelligence, artificial intelligence of things (AIoT), digital twins, etc.). Artificial intelligence (AI) is playing an increasingly important role in IoT applications and deployments. Harnessing the power of AI with the large amount of IoT data will lead to the full benefits of IoT data. This will lead to a variety of benefits such as proactive intervention, intelligent automation, highly personalized experiences, etc.

At the same time, decision-making in SSC&Cs is, by design, data-driven. Although traditional information databases and analytics architectures and infrastructures remain essential, it is useful to understand how SSC&C technologies collect, process, manage, and present data from various sources to inform municipal decision-making. These aspects touch on both specific capabilities/capacities of this process as well as general policy guidance. Another topic of importance includes potential "imperfections", or risks, in a given DPM framework, and how they affect municipal decision-making. Implementing feasible DPM guidelines and standards can make the collection, storage and retrieval of large amounts of data fast and cost-effective while addressing data complexities and governance. There is also an interest in understanding how data aspects of SSC&C services and applications are powered by emerging technologies (e.g., blockchain, artificial intelligence, metaverse, digital twins, etc.).

Taking into account the data ecosystem affecting various stakeholders, this Question will develop a set of Recommendations for effective DPM, data analysis and sharing for IoT and SSC&C, and for promoting the adoption of AI-based solutions in IoT and SSC&C.

This Question focuses on DPM, data analytics and sharing including big data aspects of IoT and SSC&C.

### D.2 Question

Study items include, but are not limited to:

– analysis of existing technologies, platforms, guidelines and standards for DPM in line with the mandate of SG20;

– architectural frameworks for the future of data driven ecosystems and their applications with DPM and big data;

– data analytics and data sharing issues with the development of efficient and scalable DPM approaches;

– the role of emerging technologies (e.g., blockchain, AI, AIoT and digital twins, etc.) to support DPM, data analytics and sharing;

– governance, security and privacy concerns within DPM, data analytics and sharing frameworks;

– trusted data and data quality in DPM, data analytics and sharing frameworks including digital identification and certification;

– collaboration with standards development organizations (SDOs) to maximize synergies and harmonize existing standards related to this field work.

### D.3 Tasks

Tasks include, but are not limited to:

– Developing Recommendations, Supplements, Reports, guidelines, etc., as appropriate, for DPM, data analytics and sharing of IoT and SC&C, covering:

 methodology for DPM concept building based on use cases, and the analysis of requirements;

 data value chain, data lifecycle, capabilities and functional architectures to support DPM including big data aspects of IoT and SSC&C;

 data analytics and data sharing to support data-driven intelligent services and applications of IoT and SSC&C;

 tools, mechanisms and standardized interfaces for data analytics and data sharing;

 DPM, data analytics and sharing with support of emerging technologies (e.g., blockchain, artificial intelligence, AIoT and digital twins, etc.) of IoT and SSC&C;

 governance, security, privacy protection and risk management of IoT and SSC&C;

 trusted data and data quality management of IoT and SSC&C.

– Providing the necessary analysis of and collaboration for joint activities in this field within ITU and between ITU-T and other relevant SDOs, consortia and forums.

An up-to-date status of work under this Question is contained in the SG20 work programme ([https://itu.int/ITU-T/workprog/wp\_search.aspx?sg=20](https://www.itu.int/ITU-T/workprog/wp_search.aspx?sg=20)).

### D.4 Relationships

Recommendations:

– Y.4000-series on IoT and smart cities & communities

– Y.4000-series on data processing and management (including ITU-T FG-DPM deliverables)

Questions:

– All ITU-T SG20 Questions

Study groups:

– ITU-T (e.g., considering their lead study group role), ITU-D and ITU-R study groups, as appropriate

– ITU-T SG13 on big data relevant aspects

Other bodies:

– 3GPP

– 5G Alliances (e.g., 5G AA, 5G ACIA, etc.)

– Alliance for IoT and Edge Computing Innovation (AIOTI)

– BDVA

– BSI

– ETSI

– GSMA

– IEEE

– IETF

– International Data Spaces Association (IDSA)

– ISO/IEC JTC 1

– Joint IEC-ISO-ITU Smart Cities Task Force

– Open & Agile Smart Cities (OASC)

– OCF

– OMA

– oneM2M

– OSG

– W3C

WSIS Action Lines:

– C2, C3, C5, C6, C7, C8, C10, C11

Sustainable Development Goals:

– SDGs 9, 10 and 11

## DRAFT QUESTION E/20Decentralized/distributed IoT

(New Question)

### E.1 Motivation

Population, climate, economic and other factors promote the continuous development of cities. The development of cities is one of important drivers for the development of Internet of things (IoT) technologies. The prosperity of cities needs support from existing IoT, evolving IoT (catering to new city requirements and adopting new technologies) and flexible, scalable, reliable and compatible interworking among existing IoT and evolving ones.

With the development of cities, decentralization/distribution has become a new demand for interoperability between IoT systems, as it can not only maintain the independence of existing IoT systems, but also promote collaboration between existing IoT systems and evolving IoT systems and between different existing/evolving IoT systems, contributing to enhancing the efficiency of digital services.

Decentralized/distributed IoT aims to enhance the features of IoT, including but not limited to openness, transparency, and reliability. These features may promote IoT integration with emerging technologies (including but not limited to blockchain/distributed ledger technologies (DLT), federated learning, and Web 3.0 related technologies) that can empower the city development to be more intelligent and sustainable. Decentralization can not only reduce the power of a single centre, increase the reliability and security of IoT systems, but also it can also improve the efficiency of resource utilization, as it allows for collaborative computing and storage on different nodes, thus helping in reducing resource waste and making the decision process more efficient.

In smart sustainable cities and communities, the special challenges that may need to be faced by decentralized/distributed IoT include but are not limited to: instability of IoT network connections, power consumption and energy waste, limited storage and computing resources, and security threats in multiple domains (devices, local area networks, public networks, edge computing assets, cloud computing assets, middle ware and applications) with zero trust or weak trust. Open-source efforts may benefit decentralized/distributed IoT related implementations.

This Question addresses use cases, requirements, capabilities, frameworks, architectures, functional entities, data models, APIs, protocols, QoS/QoE and assessment method of decentralized/distributed IoT.

### E.2 Question

Study items include, but are not limited to:

– What benefits can decentralized/distributed IoT bring to IoT stakeholders, including, but not limited to, enhancements to the efficiency of digital services?

– What are the use cases and best practices for decentralization in the IoT and SSC&C?

– What are the requirements and capabilities of decentralized/distributed IoT? What are the corresponding frameworks and architectures?

– What are the functional entities, data models, APIs and protocols of decentralized/distributed IoT?

– What are the QoS/QoE requirements of decentralized/distributed IoT and how to guarantee them?

– What are the assessment methods of decentralized/distributed IoT?

### E.3 Tasks

Tasks include, but are not limited to:

– Developing Recommendations, Reports, guidelines, etc. as appropriate on:

 development of Recommendations pertaining to the study items above as needed;

 development of non-normative deliverables pertaining to the study items above as needed;

 maintenance of Recommendations and non-normative texts under the responsibility of the Question.

### E.4 Relationships

Recommendations:

– ITU-T Y-series Recommendations addressing blockchain, DLT, decentralization/distribution, and federated learning (including Y.4560, Y.4561, Y.4464, Y.4491, Y.4483, Y.4486, Y.4492, Y.4494, Y.4052) and Y-series Supplement 62

Questions:

– All Questions of SG20

Study groups:

– ITU-T SG17 (in particular, [Q14/17] on distributed ledger technology security)

– ITU-T SG16 (in particular, [Q22/16] on multimedia aspects of distributed ledger technologies and e-services)

– ITU-T SG13

– ITU-T SG12

– ITU-T SG2

Other bodies:

– ISO TC307

– Open & Agile Smart Cities (OASC)

WSIS Action Lines:

– C1, C2, C3, C5, C6, C7, C9, C10, C11

Sustainable Development Goals:

– SDGs 9, 10, 11, 12, 13, 17

## DRAFT QUESTION F/20Architectures, functionalities, and protocols in applications of verticals and infrastructures of IoT and SSC&C

(Continuation of Question 3/20)

### F.1 Motivation

As the Internet of things (IoT) establishes its position as an underlying mechanism for various applications, special attention is being paid to how advanced information and communication technology (ICT) systems are designed based on IoT and related conceptual architectures including network requirements and protocols. Given the rich features of IoT, highly capable ICT systems meeting vertical industry demands can be realized by supplementary development based on IoT architectures. This is a promising way in terms of efficiency and time to market.

To support this approach, the IoT architectures, their functionalities, interfaces, protocols and control mechanisms, connectivity technologies need be studied, also building on existing Recommendations, including ITU-T Y.4000/Y.2060.

This Question addresses architectures, including their functionalities, interfaces, protocols and control mechanisms, interoperability technologies of IoT and smart sustainable cities and communities (SSC&C), which needed to construct architectural functionalities to interact with services and applications of verticals and infrastructures of IoT and SSC&C.

### F.2 Question

Study items include, but are not limited to:

– What new and revised Recommendations are required to realize IoT and SSC&C architectures?

– What technologies including networks, interfaces, functions, management mechanisms, as well as protocols are required for the architecture of IoT and SSC&C?

– What functionalities of the ICT technologies, protocols and control mechanisms are required to support services and/or applications of IoT and SSC&C?

– What enhancements to existing network connectivity, interfaces, functions, management mechanisms and protocols are required to support machine-to-machine (M2M) communication services and/or applications of IoT and SSC&C?

– What performance enhancement requirements of connectivity technologies are required to support services and/or applications of IoT and SSC&C?

– Collaboration with which standards development organizations (SDOs) would be necessary to maximize synergies and harmonize existing standards?

### F.3 Tasks

Tasks include, but are not limited to:

– Developing Recommendations, Reports, guidelines, etc., as appropriate, on:

 conducting studies on architectures and functional models on IoT and SSC&C services and systems based on vertical industry and infrastructure needs like power, water, city facilities etc.

 developing frameworks to identify the basic architectural compositions and views on IoT and SSC&C. These will be based on the architectural requirements derived from the industry and infrastructure needs;

 identifying entities, their functions, and reference points required to provide support to IoT applications and services;

 determining the requirements that the connectivity and protocols are intended to support. It is anticipated that these requirements will need to be periodically refined to reflect the evolution of IoT related technologies taking into consideration the connectivity, management mechanisms (including device management) and protocols available from ITU-T and other SDOs;

 developing modifications and enhancements to the network connectivity technologies, management mechanisms (including device management) and protocols that will enable them to meet the requirements and architecture IoT and SSC&C;

 identifying performance enhancement requirements of connectivity technologies that will enable them to meet the IoT and SSC&C requirements;

 identifying interfaces for which interoperability between different IoT elements is desirable and for which detailed requirements need to be studied and protocols need to be standardized;

 defining interworking with legacy systems;

 developing intelligence control related technologies that will provide support to applications and services for various verticals and infrastructures;

 identifying mechanisms for achieving architectural interoperability in IoT and SSC&C;

 open-source related matters.

– Providing the necessary analysis of and collaboration for joint activities in this field within ITU and between ITU and SDOs, consortia and forums.

An up-to-date status of work under this Question is contained in the SG20 work programme ([https://itu.int/ITU-T/workprog/wp\_search.aspx?sg=20](https://www.itu.int/ITU-T/workprog/wp_search.aspx?sg=20)).

### F.4 Relationships

Recommendations:

– Y.4000-series

Questions:

– All ITU-T SG20 Questions

Study groups:

– ITU-T (e.g. considering their lead study group role), ITU-D and ITU-R study groups, as appropriate

– IoT signalling and protocols will be developed in collaboration with ITU-T SG11

Other bodies:

– ATIS

– IETF

– ETSI

– CCSA

– TM Forum

– oneM2M

– ISO/IEC JTC 1/ WG10

– Joint IEC-ISO-ITU Smart Cities Task Force

– 3GPP/3GPP2

– IEEE

– W3C

– OCF

– Open & Agile Smart Cities (OASC)

WSIS Action Lines:

– C2, C3, C5, C6, C7, C8, C10

Sustainable Development Goals:

– SDGs 9 and 11

## DRAFT QUESTION G/20Evaluation and assessment of smart sustainable cities and communities and digital services

(Continuation of Question 7/20)

### G.1 Motivation

ITU-T Study Group 20 focuses on developing guidelines, methodologies and best practices related to standards to help cities, communities, and rural areas deliver services using relevant emerging technologies, including edge computing, metaverse, blockchain, trusted computing, digital twins, artificial intelligence (AI), machine learning (ML), data processing and analytics, orchestration and automation technologies with advanced sensing and actuation technologies, also known as smart sustainable cities and communities (SSC&C).

The service/sector offerings of SSC&C, including smart education, smart hospital, smart farming, traffic awareness, environmental protection, smart manufacturing, new energy vehicles, digital power infrastructure, energy storage business, charging business, etc., realize user-centric goals.

Given the diverse uses and types of technologies for municipal governments to create SSC&C, it is useful to undertake further studies on how municipal governments can deploy SSC&C technologies to make better-informed decisions, to effectively integrate and deliver better digital services, and to encourage comprehensive strategies to implement SSC&C principles and goals.

One of the ways to assist municipal governments in adopting SSC&C technologies is through quantitative and qualitative assessments. The use of key performance indicators (KPIs), for instance, can help measure the implementation and success of SSC&C technologies and goals.

### G.2 Question

Study items include, but are not limited to:

– General principles that could be used to establish methodologies to assess the use of information and communication technology (ICT) as well as the impact of ICT on city smartness and sustainability.

– Smart Sustainable Cities Index for worldwide use across countries and regions.

– Usefulness of different methodologies (measurement, statistics sampling, case studies, best practices, etc.) with respect to different countries and regions.

– Best methods for assessing the collection, sharing, processing, and analysis of reliable data, accounting for the evolution of that data over time.

– How to assess the achievement of the sustainable development goals (SDGs) in a smart sustainable city?

– How to assess the interworking and integration capabilities of smart sustainable city systems and platforms?

– How to evaluate and assess the use of relevant emerging technologies such as edge computing, metaverse, blockchain, trusted computing, digital twins, AI/ML, data processing and analytics, orchestration and automation technologies with advanced sensing and actuation technologies, among others, in SSC&C?

– How to evaluate and assess human-centricity and quality of human life aspects in the use of Internet of things (IoT) and SSC&C technologies?

– How to measure and evaluate a city's specific performance and digital services with respect to defined sector (or vertical) indicators such as open data indicators, e-health indicators, utilities indicators, etc.

– How to assess city resilience and robustness?

### G.3 Tasks

Tasks include, but are not limited to:

– Developing Recommendations, Reports, guidelines, etc., as appropriate, on:

 methodologies, general principles, and criteria for cities/communities to collect and analyse data for the evaluation and assessment of SSC&C technologies;

 methodologies, general principles, and criteria for cities/communities to assess their current service/sector offerings, implement relevant SSC&C technologies including edge computing, metaverse, blockchain, trusted computing, digital twins, AI, ML, data processing and analytics, orchestration and automation technologies with advanced sensing and actuation technologies, among others, and measure their impact on a local level;

 methodologies, general principles, and criteria for cities/communities to assess their current service/sector offerings, implement relevant SSC&C technologies including edge computing, metaverse, blockchain, trusted computing, digital twins, AI, ML, data processing and analytics, orchestration and automation technologies with advanced sensing and actuation technologies, among others, and measure their impact on the UN SDGs;

 methodologies, general principles, and criteria for cities/communities to assess their performance, resilience and robustness.

– Reporting on the Global Smart Sustainable Cities Index.

– Providing the necessary collaboration for joint activities in this field within ITU and between ITU-T and SDOs, UN agencies, consortia and forums.

An up-to-date status of work under this Question is contained in the SG20 work programme ([https://itu.int/ITU-T/workprog/wp\_search.aspx?sg=20](https://www.itu.int/ITU-T/workprog/wp_search.aspx?sg=20)).

### G.4 Relationships

Recommendations:

– All the pertinent Y.4000 series Recommendations and Y-series Supplements

Questions:

– All Questions of ITU-T SG20

Study groups:

– ITU-T, ITU-D and ITU-R study groups, as appropriate

Other bodies:

– IETF

– Open Mobile Alliance (OMA)

– Open Geospatial Consortium (OGC)

– IEEE

– ATIS

– ETSI TC Smart M2M

– CCSA TC10

– oneM2M

– ISO/IEC JTC 1/SC41, ISO/IEC JTC 1/WG11

– Joint IEC-ISO-ITU Smart Cities Task Force

– GSMA

– 3GPP/3GPP2

– W3C

– Open & Agile Smart Cities (OASC)

– Object Management Group (OMG)

– Industrial Internet Consortium (IIC)

– Alliance of Industrial Internet (AII)

– Alliance for IoT and Edge Computing Innovation (AIOTI)

– Open Connectivity Foundation (OCF)

WSIS Action Lines:

– C2, C3, C6, C7, C8, C10, C11

Sustainable Development Goals:

– SDGs 3, 6, 7, 9, 11 and 13

## DRAFT QUESTION H/20Interworking between smart city platforms including digital twins

(Continuation of Question 1/20)

### H.1 Motivation

City is a complex system comprised of multiple interconnected systems, and, from an information and communication technology (ICT) perspective, smart sustainable cities require the integration of various systems, devices and services to address urban challenges.

A smart city platform enables this integration amongst various systems to offer the urban operation and services supporting the functioning of city services, as well as efficiency, performance, security and scalability.

For instance, enhancing efficiency can be achieved by connecting and coordinating individual systems within cities and communities such as water, electricity, waste management and transportation and facilitating the exchange of data from different domains within cities.

Smart city platform, including digital twins for cities is recognized as a promising approach to enhance urban planning and to develop successful smart sustainable cities. In the context of digital twins, the physical reality of an urban space is replicated in a digital environment, enabling real-time interaction between the physical and virtual models. This includes activities such as real-time monitoring, analysis of various phenomena, prediction of the future through simulation, and visualization of various characteristics.

There will be many digital twins within a city. These may address different city challenges such as transport, energy, or disasters, or different parts of the city such as main railway stations, airports, or new city districts. By federating the different digital twins, challenges spanning multiple domains and areas can be addressed.

In addition to apply digital twins, cities are now trying to implement metaverse amongst other technologies to move toward to CitiVerse. The CitiVerse implies a digital representation of a city or urban environment, integrating smart sustainable city technologies, the Internet of things (IoT), and digital twins. It aims to create virtual replicas of cities to enhance urban planning, sustainability, and citizen engagement.

This Question addresses use cases, requirements, architectures and data sets and format to support interworking and between smart city platforms including digital twins in cities and communities.

### H.2 Question

Study items include, but are not limited to:

– What are the requirements, capabilities, use cases and architecture of smart city platforms including digital twins?

– What are the requirements, capabilities, use cases and architecture of interworking between smart city platforms and digital twin federation for smart sustainable cities and communities (SSC&C)?

– What are the requirements, capabilities, use cases and architecture of digital twins for CitiVerse?

### H.3 Tasks

Tasks include, but are not limited to:

– Developing Recommendations, Supplements, Reports, guidelines, etc., as appropriate, on:

 requirements, capabilities and architectures for smart city platforms including digital twins;

 requirements, capabilities and architectures for interworking between smart city platforms and digital twin federation in SSC&C;

 requirements, capabilities and architectures for digital twins for CitiVerse; and

 implementation, deployment, operation and maintenance with respect to the above tasks.

– Providing the necessary collaboration for joint activities in this field within ITU and between ITU-T and other relevant SDOs, consortia and forums.

An up-to-date status of work under this Question is contained in the SG20 work programme (<https://itu.int/ITU-T/workprog/wp_search.aspx?sg=20>).

### H.4 Relationships

Recommendations:

– Y.4000-series including Y.4100/Y.2066, Y.4111/Y.2076, Y.4113, Y.4114, Y.4200, Y.4201, Y.4401/Y.2068, Y.4461, Y.4552/Y.2078, Y.4600

Questions:

– All ITU-T SG20 Questions

Study groups:

– ITU-T (e. g. considering their lead study group role), ITU-D and ITU-R study groups, as appropriate

Other bodies:

– 3GPP

– ETSI

– IEC SyC Smart Cities

– IETF

– ISO/IEC JTC 1/SC 41, ISO/IEC JTC 1/WG 11

– ISO/TC 268

– Joint IEC-ISO-ITU Smart Cities Task Force

– Open & Agile Smart Cities (OASC)

– oneM2M

– W3C

WSIS Action Lines:

– C2, C3, C5, C6, C7, C8, C10

Sustainable Development Goals:

– SDG 11

## DRAFT QUESTION I/20Terminology and definitions, study and research of emerging digital technologies

(Continuation of Question 5/20)

### I.1 Motivation

The Internet of things (IoT) has the potential to change the lifestyle of the people and the way they interact with the surroundings, especially in smart sustainable cities and communities (SSC&C). In this regard, it is important to explore the emerging technologies and trends that will contribute to that change while considering the contribution of open source to promote the development of the Internet of things and the construction of SSC&C at low cost and fast speed. It is expected that IoT will have a significant impact on key infrastructural elements pertaining to cities, including the transportation, health and energy sectors, quality of life and environment, as well as on society and the economy as a whole. Due to its ubiquitous nature, the IoT is in direct interaction with all application domains and all countries, with a direct impact on the achievement of the Sustainable Development Goals (SDGs).

To facilitate discussions and to have a common background of relevant issues, the terminologies relating to IoT and SSC&C need to be defined, coordinated and unified. It would also be appropriate to identify, research, and analyse emerging digital technologies (e.g. artificial intelligence (AI) large language model and metaverse) that are relevant for IoT and/or SSC&C standardization. AI large language model (LLM) technology represents a significant advancement in AI as it is more fundamental, universal, powerful, and open. Gradually, LLMs are being deeply integrated with multiple vertical fields such as finance, healthcare, education, industry, gaming, as well as they become a new engine for industrial growth and a new trend for investment. This Question intends to serve as a bridge with the research community and, where appropriate, to facilitate and accelerate the transfer of emerging technologies to standardization. This Question will focus on topics that are not yet addressed by the other Questions.

This Question is tasked to capture and develop definitions, to contribute to a common terminology for IoT and SSC&C. This Question can also contribute to research solutions for interoperability across different technologies, taking into account both end-user, regulatory and market needs. Considering the rapid evolution of the IoT domain and related information technology, this Question can also contribute to the identification and discussion of relevant research and technological developments in this area, to bring the most relevant topics to the attention of the ITU-T Study Group 20 and/or to the corresponding Questions. Considering the fast evolution of IoT technologies and shorter time to market, this question is expected to serve as a facilitator with the research and innovation community in order to identify emerging technologies requiring standardization for the global market and the industry.

### I.2 Question

Study items include, but are not limited to:

– What are the terms, definitions, abbreviations, letter symbols and schematic symbols used for IoT and SSC&C?

– What are the emerging research and technologies related to IoT and/or SSC&C that may need standardization?

– How can IoT technologies contribute to implement the SDGs and World Summit on Information Society (WSIS) outcomes?

– What are the impacts of introducing IoT on human activities and how can the corresponding constraints be addressed?

– How can end-user experience with IoT be enhanced?

– How can IoT comply with regulatory requirements and how can IoT systems and components communicate information on their legal compliance with each other in a standardized manner?

– How will IoT change the business models and the market environment?

– How artificial intelligence large language model will affect our cities, our society, our economy, and our lives? What are the recommended practices for contributing to and utilizing open-source software?

– Collaboration with which standards development organizations (SDOs) would be necessary to maximize synergies and harmonize existing standards?

– How to engage with the IoT community at large, including universities and research institutes for supporting global standardization and interoperability?

### I.3 Tasks

Tasks include, but are not limited to:

– Developing Recommendations, Reports, guidelines, etc., as appropriate, on:

 developing, maintaining and enhancing the Recommendations on terminology related to IoT and SSC&C;

 maintaining and enhancing the SG20 Recommendations;

 development, in collaboration with other SG20 Questions, of frameworks and roadmaps for the harmonized and coordinated development of IoT, including machine-to-machine communications and ubiquitous sensor networks in ITU-T;

 cooperating with ITU-D and ITU-R study groups and other regional and international SDOs, academia and industry forums;

 developing guidelines, methodologies and best practices related to IoT and SSC&C to support the achievement of the SDGs and to prevent a digital gap with developing countries;

 developing guidelines, methodologies and best practices related to IoT to support legal compliance of IoT systems and solutions in a standardized and interoperable manner;

 developing guidelines, methodologies and best practices related to artificial intelligence large language model to support our cities, our society, our economy, and our lives in a standardized manner;

 developing guidelines, methodologies and best practices related to open source of technology to support the development of the Internet of things and the construction of SSC&C in a standardized manner;

 identifying emerging technologies and relevant research work on IoT and SSC&C that are relevant for standardization;

 liaising and fostering cooperation with academia, research and innovation community, as well as with other SDOs and industry forums including small and medium enterprises on IoT and SSC&C;

 identifying in coordination with other SG20 Questions, new work areas linked to IoT and SSC&C, and collaborating with relevant ITU-T SGs and other SDOs and forums, to initiate studies on those identified work areas.

– Providing the necessary analysis of and collaboration for joint activities in this field within ITU and between ITU-T and other relevant SDOs, consortia and forums.

An up-to-date status of work under this Question is contained in the SG20 work programme ([https://itu.int/ITU-T/workprog/wp\_search.aspx?sg=20](https://www.itu.int/ITU-T/workprog/wp_search.aspx?sg=20)).

### I.4 Relationships

Recommendations:

– Y.4050/Y.2069

Questions:

– All ITU-T SG20 Questions

Study groups:

– ITU-T (e.g., considering their lead study group role), ITU-D and ITU-R study groups, as appropriate

– ITU Standardization Committee for Vocabulary (SCV)

Other bodies:

– IEC

– ISO

– Joint IEC-ISO-ITU Smart Cities Task Force

– IEEE

– IETF

– IPv6 Forum

– IoT Forum

– IoT Lab

– Universities

– Research institutes

– Open Geospatial Consortium (OGC)

– 5G Alliances

– W3C

– oneM2M

– ATIS

WSIS Action Lines:

– C1, C6, C11

Sustainable Development Goals:

– SDGs 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16 and 17

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