ITUPublications

International Telecommunication Union
Standardization Sector

ITU Smart Sustainable Cities

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Contents

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Foreword

The global challenges brought on by COVID-19 have made it clear that embracing digital transformation is no longer an option, but a necessity.

Cities rely on digital infrastructure to provide critical services, enable data collection at scale, and inform decision-making. Businesses are looking to digital transformation to streamline core operations and stay competitive. And digital transformation is changing the way we think about social life and education.

This accelerated rate of digital transformation – and associated opportunities to reimagine urban planning and investment – can help us to realign urban development with pathways compatible with the United Nations Sustainable Development Goals (SDGs). But this can only be achieved if we come together internationally to develop a shared vision for a sustainable and resilient future and take collective action to realize this vision.

This brochure shares insight into how ITU standardization work and supporting collaboration initiatives are enabling shared progress towards smart sustainable cities and communities.

ITU is the United Nations specialized agency for information and communication technology (ICT). Policymakers, urban planners, industry, academia and civil society are working together to develop ITU standards able to help cities innovate efficiently and at scale. These standards support the development of master plans for the transition to smart sustainable cities, interoperability among city systems, efficient data processing and management, and much more.

ITU is also a founding member of United for Smart Sustainable Cities (U4SSC), an initiative supported by 17 United Nations partners with the aim of achieving SDG11: Make cities inclusive, safe, resilient and sustainable. More than 100 cities worldwide are evaluating their progress towards smart city objectives and the SDGs using U4SSC Key Performance Indicators for Smart Sustainable Cities based on ITU standards.

A successful digital transformation will demand broad-based collaboration to ensure that advances in ICT follow a course aligned with universal human values. ITU provides a neutral platform to build this collaboration and accelerate progress towards the SDGs. We welcome you to join our work to create a more sustainable and resilient future for all.

Chaesub Lee
Director
ITU Telecommunication Standardization Bureau

About ITU

International Telecommunication Union (ITU) is the United Nations specialized agency for information and communication technologies (ICTs).

A vital part of its work is to develop technical standards that ensure networks and technologies seamlessly interconnect, and strive to improve access to digital technologies and ICTs to underserved cities and communities worldwide.

ITU members come from all over the globe to work together to shape the future digital technology and ICT policy and regulatory environment, set standards, and formulate best practices to enhance the overall ICT ecosystem.

ITU's activities

- Standardization
- Research
- International cooperation
- Awarness-raising and events
- Collaboration and projects
- Networking and partnerships

How ITU-T works

From its inception in 1865, ITU-T drives a contribution-led, consensus-based approach to standards development in which all countries, academia and companies are afforded equal rights to influence the development of ITU-T Recommendations (ITU international standards).

ITU-T, through its ITU-T Study Group 20, provides an inclusive and conducive atmosphere to the standardization community to take a holistic approach to a digital transformation at the country, city and community level. With its core membership of 193 Members States and over 700 private-sector entities and academic institutions, ITU remains the world's truly global ICT standardization platform for smart sustainable cities.

Spotlight on cities

City challenges range from growing inequalities, urban sprawl, pollution and associated health issues, to the burgeoning impact of climate change. Many of these challenges further exacerbate one another, leading to a synergistic cycle of issues within the urban domain. In the wake of the COVID-19 pandemic cities will continue to grapple with the widening socio-economic gaps for the foreseeable future.

With over 66 per cent of the population expected to live in urban areas by 2050, cities need to reimagine the way in which resources and services are managed and delivered to improve the sustainability and efficiency of services, mitigate climate crisis and environmental risks, and safeguard the well-being of every citizen.

To curb the negative impacts of urbanization and climate change, a methodological shift encapsulating innovative solutions in urban policies is essential. With the aim of addressing cross-cutting issues in the sphere of sustainability, cities are increasingly embracing technologies to carry out their operations to cater to the needs of their inhabitants without compromising on the interests of the future generations.

"A smart sustainable city is an innovative city that uses information and communication technologies and other means to improve quality of life, efficiency of urban operation & services, and competitiveness, while ensuring that it meets the needs of present and future generations with respect to economic, social, environmental as well as cultural aspects."

Recommendation ITU-T Y.4900

What does it mean to be a Smart Sustainable City?

A smart sustainable city (SSC) places emphasis on the need for cities to be sustainable (resilient and inclusive), in addition to being smart, i.e. digitally capable. At the core of the smart sustainable city ecosystem, lies an ICT infrastructure for the provision of services and facilitation of effective decision-making.

To be acknowledged as smart and sustainable, cities and communities are encouraged to take a human-centric approach to urban development; one that takes human values into consideration when deploying digital and technological solutions.

ITU standards

ITU works closely with its membership to develop international standards on a varying range of topics within the digital technology and ICT realm. Within the Standardization sector (ITU-T), international standards are referred to as ITU-T Recommendations that support and guide the use of digital technologies and ICTs worldwide.

Standards benefit

Citizens

Business

Governments

Environment

Standards: A piece of the smart city puzzle

Smart sustainable cities and communities as well as countries, leveraging digital technologies and ICTs are increasingly becoming part of global urban discourse.

The overall integration of digital technologies and ICTs into the urban ecosystem to accelerate climate actions, is aimed at streamlining operations, facilitating decision-making and delivering better quality of life for citizens.

At the centre of any smart and sustainable city transition, lies the need for services to be interoperable, accessible, scalable and energy efficient. Standardization is key to ensuring these outcomes.

International standards can provide crucial guidance, and technical and policy recommendations that urban stakeholders can use to set their city's priorities, navigate global challenges and implement innovative solutions to accelerate digital transformation and make cities and communities, and ultimately countries, smarter and more sustainable.

The UN Sustainable Development Goals

The 17 United Nations Sustainable Development Goals (SDGs) are an urgent call for action adopted by 193 UN member states, to chart the path for the universal development agenda. These goals form an indispensable part of the 2030 Agenda for Sustainable Development, covering thematic areas ranging from poverty eradication to climate change action, promoting gender equality, conservation of biodiversity and pollution control – all of which are fundamental to urban areas.

The 2030 Agenda for Sustainable Development has also underscored the transformative potential of urbanization with a dedicated goal, SDG 11, revolving on cities and communities, which serves as an important step to empowering our cities.

It also places emphasis on clime action with SDG 13. The coupling of these goals serves as the centerpiece to realizing the global smart city dreams, benefitting communities and countries at large.

Progress towards SDG 11: 'Make cities inclusive, safe, resilient and sustainable' is more critical than ever before. ICTs and digital technologies are essential to managing cities more effectively and holistically with the aim of becoming more climate conscious – through applications such as smart buildings, smart water management, intelligent transport systems, and efficiencies in energy consumption and waste management.

ITU-T standards and the SDGs

ITU-T standards are crucial to accelerating the deployment of the Internet of things (IoT), artificial intelligence (AI), digital twin, blockchain and other frontier technologies in cities and communities. They provide necessary guidance to build a trusted infrastructure capable of supporting a large number of digital applications, overcoming silos in cities and aligning technologies, to actualize global commitments under the Sustainable Development Goals, especially SDG 11: Sustainable Cities and Communities.

Sustainable Development Goal 11

ITU-T Study Group 20 (SG20): “Internet of Things and smart cities and communities”

ITU-T Study Group 20 (ITU-T SG20) is the leading study group on “Internet of Things and smart cities and communities”. Since its inception in June 2015, ITU-T SG20 has been serving as a specialized platform for the development of international standards that enable the coordinated development of interoperable IoT-based technologies in the urban domain.

As a core part of its standardization work, SG20 also seeks to guide urban stakeholders in enabling cities to reach the targets stipulated in Sustainable Development Goal 11 (Sustainable Cities and Communities).

ITU-T Study Group 20:
Internet of Things
and Smart Cities and Communities

ITU standards and guidelines

Interoperability is key to ensuring the integration of various technologies in smart sustainable cities. Standards not only facilitate this much needed interoperability but also provide a framework for smart and sustainable city transitions. ITU standards (ITU-T Recommendations), thus, are powerful agents for change in the urban space.

These standards provide a basis for cities and communities to deploy reliable technologies, build integrated IoT ecosystems and capitalize on the resulting data. Their application allows cities to reduce energy costs and emissions through smart buildings, smart grids, and intelligent water networks at a time when cities already account for nearly 70 per cent of greenhouse gas emissions.

Furthermore, standards offer the essential technical foundation for smart and sustainable transitions and provide a guidance framework to innovate both efficiently and at scale.

The ITU Toolkit for Smart Sustainable Cities

To help cities address their most pressing needs and challenges, ITU has developed the new Toolkit for Smart Sustainable Cities (SSCs). The Toolkit provides practical guidance to urban stakeholders wishing to undertake the SSC journey by recommending key ITU resources that can help ameliorate various SSC areas and solve problems in mobility, energy, environment, economy, society, governance, circularity, and so on.

Areas of benefits

The Toolkit benefits policymakers and city leaders by highlighting solutions to address city needs and overcome challenges. These key solutions are capable of harnessing the full potential of digital technologies and ICTs for aspects such as SSC planning, smart architecture, data, accessibility, emergency management, policy, and SSC evaluation.

Industries and service providers can also refer to the ITU Toolkit to better position themselves to overcome common challenges such as security and interoperability, and to optimize verticals for smart utilities, smart homes, smart mobility and transportation, etc.

The ITU Toolkit for SSCs can provide the following benefits to city and industry stakeholders:

- Proactiveness
- Direction
- Decision-making
- Progress measurement
- Efficiency
- Transparency and accountability

SSC planning and development

SSC planning and development enables the provision of quality and innovative services to citizens, together with the creation of a safe, pleasant and inclusive urban environment.

As development of a smart sustainable city from the ground up is complex, ITU offers cities a methodical approach to SSC planning and development through a series of standards and guidance frameworks.

Getting started

1. Start with a "guide for city leaders"
2. Develop your city "master plan"
3. Set the stage for "stakeholders engagement"
4. Ensure "innovation and participation" in your SSC

SSC standardization guidance schema

Examples of ITU standards and guidelines include:

- Recommendation ITU-T Y.4904: 'Smart sustainable cities maturity model'
- Recommendation ITU-T Y.4905: 'Smart sustainable city impact assessment'
- ITU-T Series Y Sup. 32: "Guide for city leaders"
- ITU-T Series Y Sup. 33: "Master Plan"
- ITU-T Series Y Sup. 34: "Setting the stage for stakeholder engagement"
- U4SSC publication: "Enhancing innovation and participation in smart sustainable cities"

The main standards range from a step by step guide to assisting city leaders to comprehend and commence their respective smart city journeys, to a master plan that provides a conceptual layout to map future growth and development in the smart and sustainable city context.

These standards are complemented by the framework for stakeholder identification, analysis and engagement and case studies involving the leveraging of stakeholders across various domains like smart governance, smart people and smart economy.

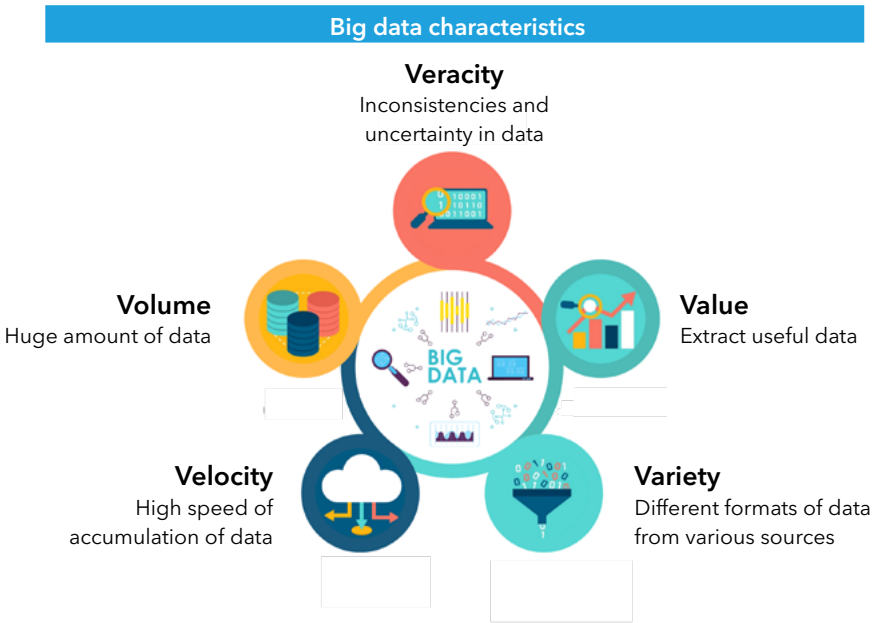
Data governance standards

Examples of ITU-T Recommendations on data governance include the following:

- Recommendation ITU-T Y.4114: 'Specific requirements and capabilities of the IoT for big data'
- Recommendation ITU-T Y.4461: 'Framework of open data in smart cities'
- Recommendation ITU-T Y.4560: 'Blockchain-based data exchange and sharing for supporting Internet of things and smart cities and communities'
- Recommendation ITU-T Y.4561: 'Blockchain-based data management for supporting Internet of things and smart cities and communities'
- Recommendation ITU-T Y.4907: 'Reference architecture of blockchain-based unified KPI data management for smart sustainable cities'
- Recommendation ITU-T Y.4470: 'Reference architecture of artificial intelligence service

Creating a "data smart" urban ecosystem

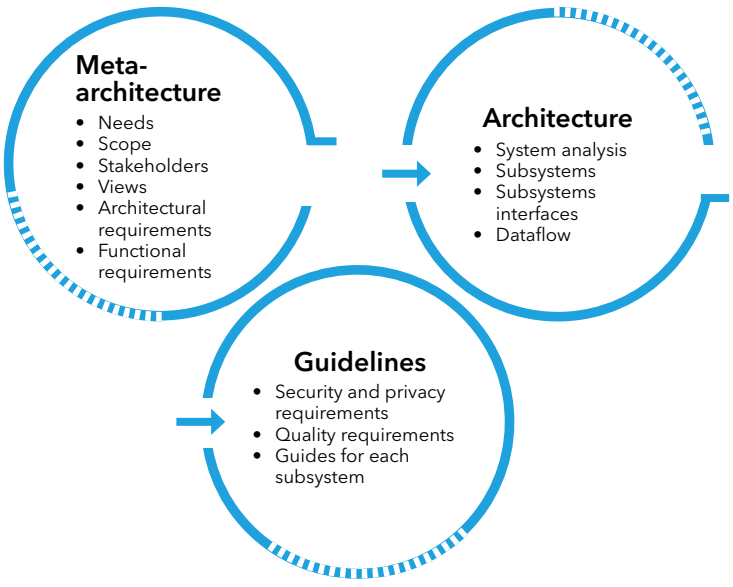
Underpinning the creation of SSCs is data management. Without data, no services can be launched in the SSC ecosystem. Deriving value from data is central to the evolution of smart sustainable cities to foster better decision-making and gain insights into how different sectors are leveraging ICTs. The data challenge in SSCs stem from the massive amounts of data that must be constantly collected, analysed and shared. For cities to be truly smart and sustainable, the network coverage requirements, security and privacy concerns and reservations linked with data analysis and regulatory necessities, should always be considered.



Smart architecture in SSCs

Smart architecture in SSCs requires ensuring interoperability, scalability, flexibility, fault tolerance, availability, manageability, resilience, and vendor independence. These factors are essential when putting in place or integrating ICTs into a city›s existing architectural framework to meet the functional requirements including security, privacy, integrated management, service delivery and information flow.

SSC ICT architecture development methodology



Requirements and architectural design for SSCs

Examples of ITU standards and guidelines include:

- ITU-T Series Y Supplement 27: “Setting the framework for an ICT architecture”
- ITU-T Recommendation Y.4500.1: “oneM2M - Functional architecture”
- ITU-T Series Y Supplement 53: “Internet of Things use cases”
- Recommendation ITU-T Y.4205: “Requirements and reference model of IoT-related crowd sourced systems”

In addition to smart city platforms (SCPs), smart residential communities (SRCs) and enterprise digital capability, many of the standards and guidelines in this area focus on IoT architecture, given that IoT already has significant impact in cities and will only continue to grow in the decades to come. By 2025, nearly 50 billion IoT-based devices will be connected to the network, generating 79.4 ZB of data.

Access control for SSCs

Examples of ITU standards and guidelines include:

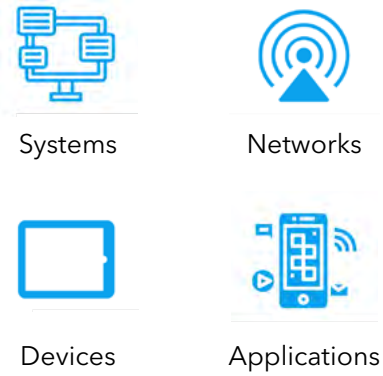
- Recommendation ITU-T Y.4807: "Agility by design for telecommunication / ICT systems security used in the IoT"
- Recommendation ITU-T Y.4806: "Security capabilities supporting safety of the Internet of things"
- Recommendation ITU-T Y.4204: "Accessibility requirements for the IoT applications and services"
- •Recommendation ITU-T Y.4211: 'Accessibility requirements for smart public transportation services'
- Recommendation ITU-T Y.2074: "Requirements for IoT devices and operation of IoT applications in disaster"
- Recommendation ITU-T Y.4116: "Requirements of transportation safety services incl. use cases and... scenarios"

Security, accessibility and emergencies

For cities initiating their SSC journey, it is essential to plan, develop and deploy IoT and smart systems in a secure manner. It is equally important for mature SSCs to validate and monitor the security of IoT and other smart applications in their city. Similarly, accessibility for citizens with special needs must be built into smart systems from the get-go, and former systems and processes be upgraded to comply with the global accessibility requirements and guidelines.

In the 21st century, digital technologies are also leveraged to reshape the urban domain for effective emergency planning and coordination of responses to emergency scenarios. In the aftermath of the COVID-19 pandemic, emerging technologies including artificial intelligence, cryptocurrencies, edge computing and autonomous systems are expected to influence all urban verticals and play a key role in continuing life as usual.

Requirements should be considered for:

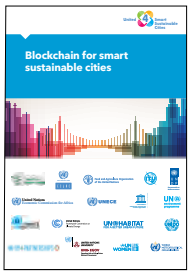


U4SSC

Cities can join the United for Smart Sustainable Cities (U4SSC) initiative (coordinated by ITU and 16 United Nations entities), to achieve Sustainable Development Goal 11: 'Make cities and human settlements inclusive, safe, resilient and sustainable'. Urban stakeholders can capitalize on the guidance frameworks developed under the umbrella of U4SSC to facilitate the use of ICTs and digital technologies for their city's transition to an SSC. Furthermore, U4SSC can serve as an ideal platform for knowledge sharing and consolidating international cooperation efforts in the realm of smart cities.

United 4 Smart Sustainable Cities

Examples of U4SSC deliverables



U4SSC thematic groups

U4SSC is currently working on the following thematic groups:

- City Platforms
- Economic and financial recovery in cities and urban resilience building in the time of COVID-19
- Guidelines on tools and mechanisms to finance SSC projects
- Guiding principles for artificial intelligence in cities
- Simple ways to be smart
- Procurement Guidelines for Smart Sustainable Cities

These thematic groups are working to set guidelines for implementing various SSC solutions efficiently and sustainably in cities.

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Spotlight on United Nations Collaboration for Smart Sustainable Cities

Understanding the importance of UN-level collaboration, on 31 October 2020, World Cities' Day, ITU and UN-Habitat, as pivotal UN agencies delving into the topic of smart and sustainable cities, signed an MoU to lay the foundation for a collaborative framework for digital transformation of cities and communities.

The U4SSC KPIs for SSC project

The approach to enhance smartness and sustainability developed by U4SSC is meant to be measurable to assess progress in the urban context. This is achieved through a set of **key performance indicators (KPIs).**

A Concept Note explaining the U4SSC KPIs project as implemented by ITU, can be found **here**.

The U4SSC KPIs and their framework can be found in the **Collection Methodology** that features requirements for assimilating ICT-based services in cities to achieve the SDGs and provides guidance on how to collect data for each KPI, along with recommendations on continuing the smart city expeditions.

ITU's implementation of the U4SSC KPIs

The U4SSC KPIs are detailed through a series of progressively elaborated reports on implementation in different cities across the globe. These include:

- City Snapshots;
- Verification Reports;
- Factsheets;
- and Case Studies.

These reports, case-studies and factsheets, along with the U4SSC KPIs Brochure and Collection Methodology, can be accessed here.

The U4SSC KPIs reporting framework

Dimensions

Economy	Environment	Society and culture
• ICT infrastructure • Water and sanitation • Drainage • Electricity supply • Transport • Public sector • Innovation • Employment • Waste • Buildings • Urban planning	• Air quality • Water and sanitation • Waste • Environmental quality • Public space and nature • Energy	• Education • Health • Culture • Housing • Social inclusion • Safety • Food security

Categories

55 core indicators + 36 advanced indicators
20 smart + 32 structural + 39 sustainable
132 data collections points

Joint Smart Cities Taskforce

ITU, ISO and IEC, the three leading standards developing organizations, have spearheaded the creation of the Joint Smart Cities Taskforce to:

- build synergies on ongoing work in ITU, IEC and ISO related to smart cities and communities;
- maximize efforts to identify new areas of cooperation on smart cities and communities;
- develop a holistic view on smart cities and communities taking into consideration the scope, areas of work and expertise of ITU, IEC and ISO in this domain.

TM Forum

In 2020, TM Forum invited ITU-T SG20 to transpose two TM Forum technical specifications which aim to provide a new set of essential API components and to further extend the cooperation for the re-use and deployment of standards across the industry.

oneM2M

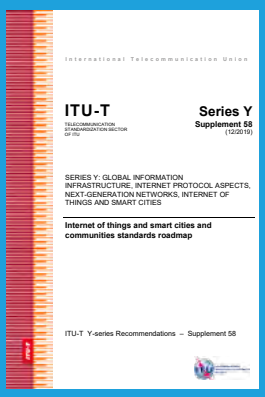
The Collaboration between oneM2M and ITU-T SG20 was initiated in July 2015 to address the need for a common M2M Service Layer that can be readily embedded within various hardware and software. The outcomes of this successful collaboration include:

- 17 oneM2M technical specifications as ITU-T Recommendations (Y.4500 series); and
- 6 oneM2M technical reports as ITU-T Technical Reports.

Joint coordination activity on IoT and SC&C

- Coordinates work on "Internet of Things (IoT) and Smart Cities & Communities (SC&C)" within ITU-T.
- Supports collaboration and coordination with other SDOs on topics on IoT and SC&C.
- Maintains up to date Supplement 58 to the ITU-T Y-series that presents the **Joint Coordination Activity on IoT and SC&C** roadmap, that contains a collection of standards & guidelines related to IoT and SC&C.

The IoT and SC&C standards roadmap



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