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| **ITU‑T Study Group 20** | | |
| INTERNET OF THINGS (IOT) AND SMART CITIES AND COMMUNITIES (SC&C) | | |
| Report of ITU-T SG20 to the World Telecommunication Standardization Assembly (WTSA-20), Part I: GENERAL | | |

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| **Abstract:** | This contribution contains the report of ITU-T Study Group 20 to WTSA-20 concerning its activities during the 2017-2021 study period. | |
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**Note by the TSB:**

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

Part I: **Document 21** – General; including proposed changes to WTSA Resolution 2 in Annex 2

Part II: **Document 22** – Questions proposed for study during the study period 2022-2024

**CONTENTS**

| Page |
| --- |
| [1 Introduction 3](#_Toc94798654)  [2 Organization of work 12](#_Toc94798655)  [3 Results of the work accomplished during the 2017-2021 study period 19](#_Toc94798656)  [4 Observations concerning future work 58](#_Toc94798657)  [5 Updates to the WTSA Resolution 2 for the 2021-2024 study period 58](#_Toc94798658)  [ANNEX 1 59](#_Toc94798659)  [ANNEX 2 69](#_Toc94798660) |
|  |

# 1 Introduction

**1.1 Responsibilities of Study Group 20**

Study Group 20 was entrusted by the World Telecommunication Standardization Assembly (Hammamet, 2016) with the study of seven (7) Questions in the area of IoT technologies, including machine-to-machine communications and ubiquitous sensor networks. A central part of this study is the standardization of end-to-end architectures for IoT, and mechanisms for the interoperability of IoT applications and datasets employed by various vertically oriented industry sectors. An important aspect of SG20's work is the development of standards that leverage IoT technologies to address urban-development challenges.

Annex A to WTSA-16 Resolution 2 states the following mandate for Study Group 20 ‘Internet of things (IoT) and smart cities and communities’:

*ITU* *Study Group 20 is responsible for studies relating to Internet of things (IoT) and its applications, and smart cities and communities (SC&C). This includes studies relating to big data aspects of IoT and SC&C, e services and smart services for SC&C.*

Annex A to WTSA-16 Resolution 2 states the following lead study group responsibilities for Study Group 20, ‘Internet of things (IoT) and smart cities and communities’:

*• Lead study group on Internet of things (IoT) and its applications*

*• Lead study group on smart cities and communities, including its e services and smart services*

*• Lead study group for Internet of things identification*

Annex B to WTSA-16 Resolution 2 provides the following points of guidance for SG20:

*ITU T Study Group 20 works on the following items:*

*• framework and roadmaps for the harmonized and coordinated development of Internet of things (IoT), including machine-to-machine (M2M) communications, ubiquitous sensor networks and smart sustainable cities, in ITU T and in close cooperation with the ITU Radiocommunication Sector (ITU R) and ITU Telecommunication Development (ITU D) study groups and other regional and international standards organizations and industry forums;*

*• requirements and capabilities of IoT and its applications including smart cities and communities (SC&C);*

*• definitions and terminology for IoT;*

*• IoT and SC&C infrastructure and services, including architecture framework and requirements of IoT for SC&C;*

*• efficient service analysis and infrastructure of IoT use in SC&C to assess how the use of IoT has an impact on the smartness of cities;*

*• guidelines, methodologies and best practices related to standards to help cities (including rural areas and villages) deliver services using IoT, with an initial view to address city challenges;*

*• IoT end-to-end architectures;*

*• identification of aspects of IoT in collaboration with Study Group 2 and Study Group 17, as per the mandate of each study group;*

*• data sets that will enable data interoperability for various verticals, including smart cities, e-agriculture, etc.;*

*• high-layer protocols and middleware for IoT systems and applications including SC&C;*

*• middleware for interoperability between IoT applications for different IoT verticals;*

*• quality of service (QoS) and end-to-end performance for IoT and its applications including SC&C;*

*• security, privacy4 and trust4 of IoT and SC&C systems, services and applications;*

*• database maintenance of existing and planned IoT standards;*

*• big data aspects of IoT and SC&C;*

*• e services and smart services for SC&C;*

*• IoT and SC&C data analytics and intelligent control.*

Annex C to WTSA-16 Resolution 2 (as modified by TSAG) defines the list of Recommendations under the responsibility of Study Group 20 in the 2017-2020 study period:

*•* ITU‑T F.744, ITU‑T F.747.1 – ITU‑T F.747.8, ITU‑T F.748.0 – ITU‑T F.748.5 and ITU‑T F.771

*•* ITU‑T H.621, ITU‑T H.623, ITU‑T H.641, ITU‑T H.642.1, ITU‑T H.642.2 and ITU‑T H.642.3

*•* ITU‑T Q.3052

*•* ITU‑T Y.4000-series, ITU‑T Y.2016, ITU‑T Y.2026, ITU‑T Y.2060 – ITU‑T Y.2070, ITU‑T Y.2074 – ITU‑T Y.2078, ITU‑T Y.2213, ITU‑T Y.2221, ITU‑T Y.2238, ITU‑T Y.2281 and ITU‑T Y.2291

NOTE – Recommendations transferred from other study groups have double numbers in the Y.4000-series.

**1.2 Management team and meetings held by Study Group 20**

Study Group 20 met eleven (11) times in plenary in the course of the study period (see Table 1) under the chairmanship of Mr Nasser Saleh Al Marzouqi as Study Group 20 chairman assisted by the following thirteen (13) Vice-Chairmen of Study Group 20: Mr Fabio Bigi (Italy), Mr Héctor Mario Carril (Argentina), Mr Bilel Chabou (Tunisia), Mr Ramy Ahmed Fathy (Egypt), Mr Hyoung Jun Kim (Korea (Rep. of)), Mr Guy-Michel Kouakou (Côte d'Ivoire), Mr Abdurahman M. Al Hassan (Saudi Arabia), Ms Blanca Gonzalez (Spain), Mr Oleg Mironnikov (Russian Federation), Mr Achime Malick Ndiaye (Senegal), Mr Ziqin Sang (China), Mr Bako Wakil (Nigeria) and Mr Takafumi Hashitani (Japan).

Ms Blanca Gonzalez (Spain) was subsequently succeeded by Ms Tania Marcos Paramio (Spain), while Mr Takafumi Hashitani (Japan) was succeeded by Mr Toru Yamada (Japan) during the study period.

Management team meetings and Working Party meetings took place in conjunction with each Study Group 20 meeting.

In addition, many Rapporteurs’ meetings (including e-meetings) took place during the study period in different locations, see Table 1-bis.

**TABLE 1  
Meetings of Study Group 20 and its Working Parties**

|  |  |  |
| --- | --- | --- |
| **Meetings** | **Place, date** | **Reports** |
| Study Group 20 | Dubai, 13-23 March 2017 | [SG20-R1](https://www.itu.int/md/meetingdoc.asp?lang=en&parent=T17-SG20-R-0001) |
| Study Group 20 | Geneva, 4-15 September 2017 | [SG20-R2](https://www.itu.int/md/meetingdoc.asp?lang=en&parent=T17-SG20-R-0002) |
| Study Group 20 WP1/20 | Geneva, 24 January 2018 | [SG20-R3](https://www.itu.int/md/meetingdoc.asp?lang=en&parent=T17-SG20-R-0003) |
| Study Group 20 | Cairo, 6-16 May 2018 | [SG20-R5](https://www.itu.int/md/meetingdoc.asp?lang=en&parent=T17-SG20-R-0005) |
| Study Group 20 | Wuxi, 3-13 December 2018 | [SG20-R6](https://www.itu.int/md/meetingdoc.asp?lang=en&parent=T17-SG20-R-0006) |
| Study Group 20 | Geneva, 9-18 April 2019 | [SG20-R7](https://www.itu.int/md/meetingdoc.asp?lang=en&parent=T17-SG20-R-0007) |
| Study Group 20 | Geneva, 25 November - 6 December 2019 | [SG20-R9](https://www.itu.int/md/meetingdoc.asp?lang=en&parent=T17-SG20-R-0009) |
| Study Group 20 | Virtual Meeting, 6-16 July 2020 | [SG20-R10](https://www.itu.int/md/meetingdoc.asp?lang=en&parent=T17-SG20-R-0010) |
| Study Group 20 WP1/20 | Virtual Meeting, 6 November 2020 | [SG20-R14](https://www.itu.int/md/meetingdoc.asp?lang=en&parent=T17-SG20-R-0014) |
| Study Group 20 | Virtual Meeting, 16 December 2020 | [SG20-R15](https://www.itu.int/md/meetingdoc.asp?lang=en&parent=T17-SG20-R-0015) |
| Study Group 20 | Virtual Meeting, 17-27 May 2021 | [SG20-R16](https://www.itu.int/md/meetingdoc.asp?lang=en&parent=T17-SG20-R-0016) |
| Study Group 20 | Virtual Meeting, 11-21 October 2021 | [SG20-R19](https://www.itu.int/md/meetingdoc.asp?lang=en&parent=T17-SG20-R-0019) |
| Study Group 20 | Virtual Meeting, 3 February 2022 | [SG20-R22](https://www.itu.int/md/meetingdoc.asp?lang=en&parent=T17-SG20-R-0022) |

**TABLE 1-bis  
Rapporteur meetings organized under Study Group 20 during the study period**

|  |  |  |  |
| --- | --- | --- | --- |
| **Dates** | **Place/Host** | **Question(s)** | **Event name** |
| 2016-11-09 to 2016-11-10 | E-Meeting | [Q3/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=4657&Group=20) [[meeting report](http://www.itu.int/md/T17-SG20-170313-TD-GEN-0115)] | Q3/20 Rapporteur group meeting |
| 2016-12-13 to 2016-12-16 | E-Meeting | [Q2/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=4654&Group=20) [[meeting report](http://www.itu.int/md/T17-SG20-170313-TD-GEN-0039)] | Q2/20 Rapporteur group meeting |
| 2016-12-16 | E-Meeting | [Q6/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=4663&Group=20) [[meeting report](http://www.itu.int/md/T17-SG20-170313-TD-GEN-0046)] | Q6/20 Rapporteur group meeting |
| 2016-12-19 | E-Meeting | [Q1/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=6772&Group=20) [[meeting report](http://www.itu.int/md/T17-SG20-170313-TD-GEN-0060)] | Q1/20 Rapporteur group meeting |
| 2016-12-19 to 2016-12-20 | E-Meeting | [Q3/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=4658&Group=20) [[meeting report](http://www.itu.int/md/T17-SG20-170313-TD-GEN-0115)] | Q3/20 Rapporteur group meeting |
| 2017-01-19 | E-Meeting | [Q5/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=4661&Group=20) [[meeting report](http://www.itu.int/md/T17-SG20-170313-TD-GEN-0065)] | Q5/20 Rapporteur group meeting |
| 2017-01-23 to 2017-01-25 | E-Meeting | [Q2/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=4655&Group=20) [[meeting report](http://www.itu.int/md/T17-SG20-170313-TD-GEN-0055)] | Q2/20 Rapporteur group meeting |
| 2017-02-23 | E-Meeting | [Q1/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=6788&Group=20) [[meeting report](http://www.itu.int/md/T17-SG20-170313-TD-GEN-0107)] | Q1/20 Rapporteur group meeting |
| 2017-05-15 to 2017-05-18 | E-Meeting | [Q2/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=6879&Group=20) [[meeting report](http://www.itu.int/md/T17-SG20-170904-TD-GEN-0278)] | Q2/20 Rapporteur meeting |
| 2017-06-15 to 2017-06-16 | E-Meeting | [Q3/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=6881&Group=20) [[meeting report](http://www.itu.int/md/T17-SG20-170904-TD-GEN-0369)] | Q3/20 Rapporteur meeting |
| 2017-07-19 | E-Meeting | [Q7/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=8922&Group=20) [[meeting report](http://www.itu.int/md/T17-SG20-170904-TD-GEN-0335)] | Q7/20 Rapporteur group meeting |
| 2017-07-20 to 2017-07-28 | Switzerland [Geneva] | [Q1/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=6886&Group=20) [[meeting report](http://www.itu.int/md/T17-SG20-170904-TD-GEN-0319)] [Q2/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=6887&Group=20) [[meeting report](http://www.itu.int/md/T17-SG20-170904-TD-GEN-0305)] [Q3/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=6888&Group=20) [[meeting report](http://www.itu.int/md/T17-SG20-170904-TD-GEN-0326)] [Q4/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=6889&Group=20) [[meeting report](http://www.itu.int/md/T17-SG20-170904-TD-GEN-0345)] [Q6/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=6890&Group=20) [[meeting report](http://www.itu.int/md/T17-SG20-170904-TD-GEN-0303)] | Interim Rapporteur group meetings of SG20 |
| 2017-12-04 to 2017-12-07 | E-Meeting | [Q2/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=9062&Group=20) [[meeting report](http://www.itu.int/md/T17-SG20-180124-TD-GEN-0567)] | Q2/20 Rapporteur group meeting |
| 2017-12-13 | E-Meeting | [Q5/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=9065&Group=20) [[meeting report](http://www.itu.int/md/T17-SG20-180506-TD-GEN-0691)] | Q5/20 Rapporteur group meeting |
| 2017-12-13 to 2017-12-14 | E-Meeting | [Q3/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=9063&Group=20) [[meeting report](http://www.itu.int/md/T17-SG20-180124-TD-GEN-0572)] | Q3/20 Rapporteur group meeting |
| 2018-01-15 to 2018-01-23 | Switzerland [Geneva] | [Q1/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=9058&Group=20) [[meeting report](http://www.itu.int/md/T17-SG20-180124-TD-GEN-0591)] [Q2/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=9059&Group=20) [[meeting report](http://www.itu.int/md/T17-SG20-180124-TD-GEN-0592)] [Q3/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=9060&Group=20) [[meeting report](http://www.itu.int/md/T17-SG20-180124-TD-GEN-0593)] [Q4/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=9061&Group=20) [[meeting report](http://www.itu.int/md/T17-SG20-180124-TD-GEN-0594)] | Interim Rapporteur group meetings of SG20 |
| 2018-03-07 to 2018-03-09 | E-Meeting | [Q2/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=9168&Group=20) [[meeting report](http://www.itu.int/md/T17-SG20-180506-TD-GEN-0708)] | Q2/20 Rapporteur group meeting |
| 2018-03-26 | E-Meeting | [Q3/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=9169&Group=20) [[meeting report](http://www.itu.int/md/T17-SG20-180506-TD-GEN-0741)] | Q3/20 Rapporteur group meeting |
| 2018-04-04 | E-Meeting | [Q7/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=9073&Group=20) [[meeting report](http://www.itu.int/md/T17-SG20-180506-TD-GEN-0744)] | Q7/20 Rapporteur group meeting |
| 2018-04-13 | E-Meeting | [Q5/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=9256&Group=20) [[meeting report](http://www.itu.int/md/T17-SG20-180506-TD-GEN-0752)] | Q5/20 Rapporteur group meeting |
| 2018-07-26 | E-Meeting | [Q6/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=9321&Group=20) [[meeting report](http://www.itu.int/md/T17-SG20-181203-TD-GEN-0994)] | Q6/20 Rapporteur group meeting |
| 2018-08-08 | E-Meeting | [Q6/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=9322&Group=20) [[meeting report](http://www.itu.int/md/T17-SG20-181203-TD-GEN-0994)] | Q6/20 Rapporteur group meeting |
| 2018-08-23 | E-Meeting | [Q6/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=9394&Group=20) [[meeting report](http://www.itu.int/md/T17-SG20-181203-TD-GEN-0994)] | Q6/20 Rapporteur group meeting |
| 2018-08-30 | E-Meeting | [Q6/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=9404&Group=20) [[meeting report](http://www.itu.int/md/T17-SG20-181203-TD-GEN-0994)] | Q6/20 Rapporteur group meeting |
| 2018-09-05 | E-Meeting | [Q3/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=9318&Group=20) [[meeting report](http://www.itu.int/md/T17-SG20-181203-TD-GEN-0912)] | Q3/20 Rapporteur group meeting |
| 2018-09-06 | E-Meeting | [Q4/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=9319&Group=20) [[meeting report](http://www.itu.int/md/T17-SG20-181203-TD-GEN-0936)] | Q4/20 Rapporteur group meeting |
| 2018-09-11 | E-Meeting | [Q5/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=9320&Group=20) [[meeting report](http://www.itu.int/md/T17-SG20-181203-TD-GEN-0987)] | Q5/20 Rapporteur group meeting |
| 2018-09-26 | E-Meeting | [Q7/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=9323&Group=20) [[meeting report](http://www.itu.int/md/T17-SG20-181203-TD-GEN-0921)] | Q7/20 Rapporteur group meeting |
| 2018-10-08 to 2018-10-10 | E-Meeting | [Q2/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=9317&Group=20) [[meeting report](http://www.itu.int/md/T17-SG20-181203-TD-GEN-0928)] | Q2/20 Rapporteur group meeting |
| 2018-10-23 | E-Meeting | [Q6/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=9430&Group=20) [[meeting report](http://www.itu.int/md/T17-SG20-181203-TD-GEN-0994)] | Q6/20 Rapporteur group meeting |
| 2018-10-31 | E-Meeting | [Q7/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=9420&Group=20) [[meeting report](http://www.itu.int/md/T17-SG20-181203-TD-GEN-0940)] | Q7/20 Rapporteur group meeting |
| 2018-11-02 | E-Meeting | [Q6/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=9459&Group=20) [[meeting report](http://www.itu.int/md/T17-SG20-181203-TD-GEN-0994)] | Q6/20 Rapporteur group meeting |
| 2019-02-13 to 2019-02-14 | E-Meeting | [Q1/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=9526&Group=20) [[meeting report](http://www.itu.int/md/T17-SG20-190409-TD-GEN-1175)] | Q1/20 Rapporteur group meeting |
| 2019-02-25 to 2019-03-01 | E-Meeting | [Q2/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=9527&Group=20) [[meeting report](http://www.itu.int/md/T17-SG20-190409-TD-GEN-1180)] | Q2/20 Rapporteur group meeting |
| 2019-02-26 | E-Meeting | [Q7/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=9515&Group=20) [[meeting report](http://www.itu.int/md/T17-SG20-190409-TD-GEN-1176)] | Q7/20 Rapporteur group meeting |
| 2019-02-27 | E-Meeting | [Q4/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=9553&Group=20) [[meeting report](http://www.itu.int/md/T17-SG20-190409-TD-GEN-1186)] | Q4/20 Rapporteur group meeting |
| 2019-03-05 to 2019-03-06 | E-Meeting | [Q3/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=9528&Group=20) [[meeting report](http://www.itu.int/md/T17-SG20-190409-TD-GEN-1202)] | Q3/20 Rapporteur group meeting |
| 2019-04-01 | E-Meeting | [Q6/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=9513&Group=20) [[meeting report](http://www.itu.int/md/T17-SG20-190409-TD-GEN-1209)] | Q6/20 Rapporteur group meeting |
| 2019-06-04 to 2019-06-05 | E-Meeting | [Q3/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=9634&Group=20) [[meeting report](http://www.itu.int/md/T17-SG20-191125-TD-GEN-1445)] | Q3/20 Rapporteur group meeting |
| 2019-07-22 to 2019-07-26 | Switzerland [Geneva] | [Q1/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=9628&Group=20) [[meeting report](http://www.itu.int/md/T17-SG20-191125-TD-GEN-1349)] [Q2/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=9629&Group=20) [[meeting report](http://www.itu.int/md/T17-SG20-191125-TD-GEN-1345)] [Q3/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=9630&Group=20) [[meeting report](http://www.itu.int/md/T17-SG20-191125-TD-GEN-1358)] [Q4/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=9631&Group=20) [[meeting report](http://www.itu.int/md/T17-SG20-191125-TD-GEN-1370)] [Q6/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=9632&Group=20) [[meeting report](http://www.itu.int/md/T17-SG20-191125-TD-GEN-1380)] | Interim Rapporteur group meetings of SG20 |
| 2019-09-26 to 2019-09-27 | E-Meeting | [Q4/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=9635&Group=20) [[meeting report](http://www.itu.int/md/T17-SG20-191125-TD-GEN-1421)] | Q4/20 rapporteur group meeting |
| 2019-10-08 to 2019-10-11 | E-Meeting | [Q2/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=9633&Group=20) [[meeting report](http://www.itu.int/md/T17-SG20-191125-TD-GEN-1432)] | Q2/20 Rapporteur group meeting |
| 2019-10-09 | E-Meeting | [Q7/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=9640&Group=20) [[meeting report](http://www.itu.int/md/T17-SG20-191125-TD-GEN-1443)] | Q7/20 Rapporteur group meeting |
| 2020-02-06 to 2020-02-07 | E-Meeting | [Q3/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=9919&Group=20) [[meeting report](http://www.itu.int/md/T17-SG20-200706-TD-GEN-1670)] | Q3/20 Rapporteur group meeting |
| 2020-02-26 | E-Meeting | [Q5/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=9918&Group=20) [[meeting report](http://www.itu.int/md/T17-SG20-200706-TD-GEN-1671)] | Q5/20 Rapporteur group meeting |
| 2020-03-26 to 2020-04-02 | E-Meeting | [Q1/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=10032&Group=20) [[meeting report](http://www.itu.int/md/T17-SG20-200706-TD-GEN-1686)] | Q1/20 e-meeting |
| 2020-03-26 to 2020-04-03 | E-Meeting | [Q3/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=10035&Group=20) [[meeting report](http://www.itu.int/md/T17-SG20-200706-TD-GEN-1687)] | Q3/20 e-meeting |
| 2020-03-27 to 2020-04-03 | E-Meeting | [Q2/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=10034&Group=20) [[meeting report](http://www.itu.int/md/T17-SG20-200706-TD-GEN-1674)] | Q2/20 e-meeting |
| 2020-03-30 to 2020-04-01 | E-Meeting | [Q4/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=10033&Group=20) [[meeting report](http://www.itu.int/md/T17-SG20-200706-TD-GEN-1694)] | Q4/20 e-meeting |
| 2020-04-07 | E-Meeting | [Q5/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=10068&Group=20) [[meeting report](http://www.itu.int/md/T17-SG20-200706-TD-GEN-1708)] | Q5/20 Rapporteur group meeting |
| 2020-05-12 to 2020-05-13 | E-Meeting | [Q3/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=9920&Group=20) [[meeting report](http://www.itu.int/md/T17-SG20-200706-TD-GEN-1718)] | Q3/20 Rapporteur group meeting |
| 2020-05-19 | E-Meeting | [Q1/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=10123&Group=20) [Q2/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=10124&Group=20) [Q3/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=10125&Group=20) [Q4/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=10126&Group=20) [Q5/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=10127&Group=20) [Q6/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=10128&Group=20) [Q7/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=10129&Group=20) | ITU-T SG20 and WTSA-2020 preparations |
| 2020-05-20 | E-Meeting | [Q7/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=10116&Group=20) [[meeting report](http://www.itu.int/md/T17-SG20-200706-TD-GEN-1732)] | Q7/20 Rapporteur group meeting |
| 2020-05-26 | E-Meeting | [Q1/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=10224&Group=20) [Q2/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=10225&Group=20) [Q3/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=10226&Group=20) [Q4/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=10227&Group=20) [Q5/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=10228&Group=20) [Q6/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=10229&Group=20) [Q7/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=10230&Group=20) | SG20 and WTSA preparations: QD/20 |
| 2020-05-27 | E-Meeting | [Q1/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=10203&Group=20) [Q2/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=10204&Group=20) [Q3/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=10205&Group=20) [Q4/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=10206&Group=20) [Q5/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=10207&Group=20) [Q6/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=10208&Group=20) [Q7/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=10209&Group=20) | SG20 and WTSA preparations: QC/20 |
| 2020-05-27 | E-Meeting | [Q1/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=10168&Group=20) [Q2/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=10169&Group=20) [Q3/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=10170&Group=20) [Q4/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=10171&Group=20) [Q5/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=10172&Group=20) [Q6/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=10173&Group=20) [Q7/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=10174&Group=20) | SG20 and WTSA preparations: QA/20 |
| 2020-05-28 | E-Meeting | [Q6/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=10112&Group=20) [[meeting report](http://www.itu.int/md/T17-SG20-200706-TD-GEN-1736)] | Q6/20 Rapporteur group meeting |
| 2020-05-28 | E-Meeting | [Q5/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=10114&Group=20) [[meeting report](http://www.itu.int/md/T17-SG20-200706-TD-GEN-1734)] | Q5/20 Rapporteur group meeting |
| 2020-05-29 | E-Meeting | [Q1/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=10245&Group=20) [Q2/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=10246&Group=20) [Q3/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=10247&Group=20) [Q4/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=10248&Group=20) [Q5/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=10249&Group=20) [Q6/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=10250&Group=20) [Q7/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=10251&Group=20) | SG20 and WTSA preparations: QE/20 |
| 2020-05-29 | E-Meeting | [Q1/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=10266&Group=20) [Q2/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=10267&Group=20) [Q3/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=10268&Group=20) [Q4/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=10269&Group=20) [Q5/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=10270&Group=20) [Q6/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=10271&Group=20) [Q7/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=10272&Group=20) | SG20 and WTSA preparations: QG/20 |
| 2020-06-01 to 2020-06-03 | E-Meeting | [Q4/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=10111&Group=20) [[meeting report](http://www.itu.int/md/T17-SG20-200706-TD-GEN-1743)] | Q4/20 Rapporteur group meeting |
| 2020-06-01 | E-Meeting | [Q1/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=10231&Group=20) [Q2/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=10232&Group=20) [Q3/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=10233&Group=20) [Q4/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=10234&Group=20) [Q5/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=10235&Group=20) [Q6/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=10236&Group=20) [Q7/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=10237&Group=20) | SG20 and WTSA preparations: QD/20 |
| 2020-06-02 | E-Meeting | [Q1/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=10175&Group=20) [Q2/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=10176&Group=20) [Q3/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=10177&Group=20) [Q4/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=10178&Group=20) [Q5/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=10179&Group=20) [Q6/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=10180&Group=20) [Q7/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=10181&Group=20) | SG20 and WTSA preparations: QA/20 |
| 2020-06-03 | E-Meeting | [Q6/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=10280&Group=20) [[meeting report](http://www.itu.int/md/T17-SG20-200706-TD-GEN-1752)] | Q6/20 Rapporteur group meeting with oneM2M experts |
| 2020-06-04 | E-Meeting | [Q1/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=10210&Group=20) [Q2/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=10211&Group=20) [Q3/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=10212&Group=20) [Q4/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=10213&Group=20) [Q5/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=10214&Group=20) [Q6/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=10215&Group=20) [Q7/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=10216&Group=20) | SG20 and WTSA preparations: QC/20 |
| 2020-06-04 | E-Meeting | [Q1/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=10189&Group=20) [Q2/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=10190&Group=20) [Q3/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=10191&Group=20) [Q4/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=10192&Group=20) [Q5/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=10193&Group=20) [Q6/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=10194&Group=20) [Q7/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=10195&Group=20) | SG20 and WTSA preparations: QB/20 |
| 2020-06-08 | E-Meeting | [Q1/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=10259&Group=20) [Q2/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=10260&Group=20) [Q3/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=10261&Group=20) [Q4/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=10262&Group=20) [Q5/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=10263&Group=20) [Q6/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=10264&Group=20) [Q7/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=10265&Group=20) | SG20 and WTSA preparations: QF/20 |
| 2020-06-09 | E-Meeting | [Q1/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=10238&Group=20) [Q2/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=10239&Group=20) [Q3/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=10240&Group=20) [Q4/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=10241&Group=20) [Q5/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=10242&Group=20) [Q6/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=10243&Group=20) [Q7/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=10244&Group=20) | SG20 and WTSA preparations: QD/20 |
| 2020-06-10 | E-Meeting | [Q1/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=10252&Group=20) [Q2/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=10253&Group=20) [Q3/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=10254&Group=20) [Q4/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=10255&Group=20) [Q5/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=10256&Group=20) [Q6/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=10257&Group=20) [Q7/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=10258&Group=20) | SG20 and WTSA preparations: QE/20 |
| 2020-06-16 | E-Meeting | [Q6/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=10340&Group=20) [[meeting report](http://www.itu.int/md/T17-SG20-200706-TD-GEN-1752)] | Q6/20 Rapporteur group meeting with oneM2M experts |
| 2020-06-19 | E-Meeting | [Q6/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=11461&Group=20) [[meeting report](http://www.itu.int/md/T17-SG20-200706-TD-GEN-1752)] | Q6/20 Rapporteur group meeting with oneM2M experts |
| 2020-06-22 | E-Meeting | [Q1/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=10309&Group=20) [[meeting report](http://www.itu.int/md/T17-SG20-200706-TD-GEN-1764)] [Q2/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=10310&Group=20) [[meeting report](http://www.itu.int/md/T17-SG20-200706-TD-GEN-1764)] [Q3/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=10311&Group=20) [[meeting report](http://www.itu.int/md/T17-SG20-200706-TD-GEN-1764)] [Q4/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=10312&Group=20) [[meeting report](http://www.itu.int/md/T17-SG20-200706-TD-GEN-1764)] [Q5/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=10313&Group=20) [[meeting report](http://www.itu.int/md/T17-SG20-200706-TD-GEN-1764)] [Q6/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=10314&Group=20) [[meeting report](http://www.itu.int/md/T17-SG20-200706-TD-GEN-1764)] [Q7/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=10315&Group=20) [[meeting report](http://www.itu.int/md/T17-SG20-200706-TD-GEN-1764)] | ITU-T SG20 and WTSA-2020 preparations |
| 2020-06-23 | E-Meeting | [Q1/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=10316&Group=20) [[meeting report](http://www.itu.int/md/T17-SG20-200706-TD-GEN-1764)] [Q2/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=10317&Group=20) [[meeting report](http://www.itu.int/md/T17-SG20-200706-TD-GEN-1764)] [Q3/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=10318&Group=20) [[meeting report](http://www.itu.int/md/T17-SG20-200706-TD-GEN-1764)] [Q4/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=10319&Group=20) [[meeting report](http://www.itu.int/md/T17-SG20-200706-TD-GEN-1764)] [Q5/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=10320&Group=20) [[meeting report](http://www.itu.int/md/T17-SG20-200706-TD-GEN-1764)] [Q6/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=10321&Group=20) [[meeting report](http://www.itu.int/md/T17-SG20-200706-TD-GEN-1764)] [Q7/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=10322&Group=20) [[meeting report](http://www.itu.int/md/T17-SG20-200706-TD-GEN-1764)] | ITU-T SG20 and WTSA-2020 preparations |
| 2020-06-24 | E-Meeting | [Q1/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=10323&Group=20) [[meeting report](http://www.itu.int/md/T17-SG20-200706-TD-GEN-1764)] [Q2/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=10324&Group=20) [[meeting report](http://www.itu.int/md/T17-SG20-200706-TD-GEN-1764)] [Q3/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=10325&Group=20) [[meeting report](http://www.itu.int/md/T17-SG20-200706-TD-GEN-1764)] [Q4/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=10326&Group=20) [[meeting report](http://www.itu.int/md/T17-SG20-200706-TD-GEN-1764)] [Q5/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=10327&Group=20) [[meeting report](http://www.itu.int/md/T17-SG20-200706-TD-GEN-1764)] [Q6/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=10328&Group=20) [[meeting report](http://www.itu.int/md/T17-SG20-200706-TD-GEN-1764)] [Q7/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=10329&Group=20) [[meeting report](http://www.itu.int/md/T17-SG20-200706-TD-GEN-1764)] | ITU-T SG20 and WTSA-2020 preparations |
| 2020-09-09 to 2020-09-10 | E-Meeting | [Q1/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=11520&Group=20) [[meeting report](https://www.itu.int/md/meetingdoc.asp?lang=en&parent=T17-SG20-201106-TD-GEN-1914)] | Q1/20 Rapporteur group meeting |
| 2020-09-14 to 2020-09-15 | E-Meeting | [Q3/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=10325&Group=20) [[meeting report](https://www.itu.int/md/meetingdoc.asp?lang=en&parent=T17-SG20-201106-TD-GEN-1928)] | Q3/20 Rapporteur group meeting |
| 2020-11-02  to  2020-11-05 | E-Meeting | [Q1/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=11539&Group=20) [[meeting report](https://www.itu.int/md/T17-SG20-201106-TD-GEN-1921)] | Q1/20 Rapporteur group meetings |
| 2020-11-02  to  2020-11-05 | E-Meeting | [Q2/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=11540&Group=20) [[meeting report](https://www.itu.int/md/T17-SG20-201106-TD-GEN-1922)] | Q2/20 Rapporteur group meetings |
| 2020-11-02  to  2020-11-05 | E-Meeting | [Q3/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=11541&Group=20) [[meeting report](https://www.itu.int/md/T17-SG20-201106-TD-GEN-1923)] | Q3/20 Rapporteur group meetings |
| 2020-11-02  to  2020-11-05 | E-Meeting | [Q4/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=11542&Group=20) [[meeting report](https://www.itu.int/md/T17-SG20-201106-TD-GEN-1924)] | Q4/20 Rapporteur group meetings |
| 2021-02-01 to 2021-02-03 | E-Meeting | [Q3/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=11796&Group=20) [[meeting report](https://www.itu.int/md/T17-SG20-210517-TD-GEN-2076)] | Q3/20 Rapporteur group meeting |
| 2021-02-02 to 2021-02-04 | E-Meeting | [Q1/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=11794&Group=20) [[meeting report](https://www.itu.int/md/T17-SG20-210517-TD-GEN-2073)] | Q1/20 Rapporteur group meeting |
| 2021-02-22 to 2021-02-25 | E-Meeting | [Q2/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=11795&Group=20) [[meeting report](https://www.itu.int/md/T17-SG20-210517-TD-GEN-2088)] | Q2/20 Rapporteur group meeting |
| 2021-02-23 to 2021-02-25 | E-Meeting | [Q4/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=12343&Group=20) [[meeting report](https://www.itu.int/md/T17-SG20-210517-TD-GEN-2103)] | Q4/20 Rapporteur group meeting |
| 2021-03-24 | E-Meeting | [Q7/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=11518&Group=20) [[meeting report](https://www.itu.int/md/T17-SG20-210517-TD-GEN-2118)] | Q7/20 Rapporteur group meeting |
| 2021-06-28 to 2021-07-02 | E-Meeting | [Q2/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=12612&Group=20) [[meeting report](https://www.itu.int/md/T17-SG20-211011-TD-GEN-2311)] | Q2/20 Rapporteur group meeting |
| 2021-07-15 to 2021-07-16 | E-Meeting | [Q3/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=12614&Group=20) [[meeting report](https://www.itu.int/md/T17-SG20-211011-TD-GEN-2335)] | Q3/20 Rapporteur group meeting |
| 2021-07-21 | E-Meeting | [Q4/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=12615&Group=20) [[meeting report](https://www.itu.int/md/T17-SG20-211011-TD-GEN-2331)] | Q4/20 Rapporteur group meeting |
| 2021-07-21 to 2021-07-22 | E-Meeting | [Q1/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=12611&Group=20) [[meeting report](https://www.itu.int/md/T17-SG20-211011-TD-GEN-2322)] | Q1/20 Rapporteur group meeting |
| 2021-09-07 to 2021-09-09 | E-Meeting | [Q2/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=12613&Group=20) [[meeting report](https://www.itu.int/md/T17-SG20-211011-TD-GEN-2373)] | Q2/20 Rapporteur group meeting |
| 2021-09-20 | E-Meeting | [Q7/20](http://www.itu.int/net/itu-t/lists/rgmdetails.aspx?id=12617&Group=20) [[meeting report](https://www.itu.int/md/T17-SG20-211011-TD-GEN-2381)] | Q7/20 Rapporteur group meeting |
| 2021-12-01 to 2021-12-02 | E-Meeting | Q1/20 | Q1/20 Rapporteur group meeting |
| 2021-12-14 to 2021-12-16 | E-Meeting | Q2/20 | Q2/20 Rapporteur group meeting |
| 2022-01-19 to 2022-01-21 | E-Meeting | Q4/20 | Q4/20 Rapporteur group meeting |
| 2022-01-19 | E-Meeting | Q4/20 | Correspondence Group on AIoT activities |
| 2022-01-20 | E-Meeting | Q6/20 | Q6/20 Rapporteur group meeting with oneM2M experts |

# 2 Organization of work

**2.1 Organization of studies and allocation of work**

**2.1.1** At its first meeting of the study period, Study Group 20 decided to establish two (2) Working Parties.

**2.1.2** Table 2 shows the number and title of each Working Party, together with the number of Questions assigned to it and the name of its Chairman.

**2.1.3** Table 3 lists other groups created by Study Group 20 during the study period.

**2.1.4** In line with Resolution 54 (rev., Hammamet, 2016), the following Regional Groups for SG20 were created:

* ITU-T SG20 Regional Group for Eastern Europe, Central Asia and Transcaucasia (SG20RG-EECAT); see section 3.3.5.
* ITU-T SG20 Regional Group for the Latin America Region (SG20RG-LATAM); see section 3.3.6.
* ITU-T SG20 Regional Group for the Africa Region (SG20RG-AFR); see section 3.3.7.
* ITU-T SG20 Regional Group for the Arab Region (SG20RG-ARB); see section 3.3.8.

**2.1.5** During the study period, one **Joint Coordination Activity (JCA)** proposed initially by Study Group 11 and transferred to Study Group 20 by TSAG in June 2015 was continued and endorsed by TSAG.

* **Joint Coordination Activity on Internet of Things and Smart Cities and Communities (JCA-IoT and SC&C)**

The Joint Coordination Activity on Internet of Things and Smart Cities and Communities (JCA-IoT and SC&C) continued from the former study period with the objective to coordinate the ITU-T work on the “Internet of Things and Smart Cities and Communities” and provide a visible contact point for IoT and its applications including smart cities and communities (SC&C) activities within ITU-T. This would also help to coordinate with external bodies working in the field of IoT and SC&C and enable effective two-way communication with these bodies. Highlights of achievements of the JCA-IoT SC&C are given in 3.3.4.

**2.1.6** During the study period, two **Focus Groups** were created by Study Group 20.

* **Focus Group on Data Processing and Management to support IoT and Smart Cities & Communities (FG-DPM)**

The Focus Group played a role in providing a platform to share views, to develop a series of deliverables, and showcasing initiatives, projects, and standards activities linked to data processing and management and establishment of IoT ecosystem solutions for data focused cities. Highlights of achievements of the FG-DPM are given in 3.3.9.

* **Focus Group on Artificial Intelligence (AI) and Internet of Things (IoT) for Digital Agriculture (FG-AI4A)**

The Focus Group will explore the potential of emerging technologies including AI and IoT in supporting data acquisition and handling, improving modelling from a growing volume of agricultural and geospatial data, and providing effective communication for interventions related to the optimization of agricultural production processes.

**2.1.7 Correspondence Group on Artificial intelligence of Things (CG-AIoT)**

The correspondence group on Artificial intelligence of Things (CG-AIoT) was created at the SG20 meeting that took place virtually on 11-21 October 2021. CG-AIoT will study AIoT technologies and analyse technical features from a standardization perspective. The group will be convened by Mr Gyu Myoung Lee (KAIST, Rep. of Korea). The CG-AIoT will use the email list [cg-aiot@lists.itu.int](mailto:cg-aiot@lists.itu.int).

**TABLE 2  
Organization of Study Group 20**

| **Designation** | **Questions to be studied** | **Title of the Working Party** | **Chairman and Vice-Chairmen** |
| --- | --- | --- | --- |
| WP1/20 | Q1/20; Q2/20; Q3/20; Q4/20; | None | Mr Fathy Ramy Ahmed (Co-chairman) Mr Kim Hyoung Jun (Co-chairman) Mr Hochman Leonel (Vice-chairman) |
| WP2/20 | Q5/20; Q6/20; Q7/20; | None | Mr Grewal Harinderpal Singh (Co-chairman) Mr Sang Ziqin (Co-chairman) Mr AbouAlmal Abdulhadi (Vice-chairman) Ms Marcos Paramio Tania (Vice-chairman) Mr Zichy Franz (Inactive Vice-chairman) Ms LaPointe Adriane (Inactive Vice-chairman) |

**TABLE 3  
Other Groups (if any)**

|  |  |  |
| --- | --- | --- |
| **Title of the Group** | **Chairman** | **Vice-Chairmen** |
| ITU-T SG20 Regional Group for the Africa Region (SG20RG-AFR) | Mr Wakil Bako (1) | Mr Abbassene Ali (3) Mr Chabou Bilel (2) Mr Fathy Ramy Ahmed (3) Mr King Melvin (2) Mr Kouakou Guy-Michel (2) Mr Manasseh Emmanuel (4) Mr Ndiaye Achime Malick (2) |
| ITU-T SG20 Regional Group for the Arab Region (SG20RG-ARB) | Mr M. Al Hassan Abdurahman (1) | Mr Abbassene Ali (2) Mr AbouAlmal Abdulhadi (2) Mr Al-Azemi Khaled (3) Mr Chabou Bilel (2) Mr Fathy Ramy Ahmed (2) |
| ITU-T SG20 Regional Group for Eastern Europe, Central Asia and Transcaucasia (SG20RG-EECAT) | Mr Borodin Alexey (1) | Ms Musaeva Umida (3) |
| ITU-T SG20 Regional Group for the Latin American Region (SG20RG-LATAM) | Mr Martín Juan Pablo (7)(9)  Mr Rodas Edgard (Inactive Chairman) (6)(8)  Mr Héctor Mario Carril (Inactive Chairman) (5) | Mr Budé Héctor (2) Mr Checo Neil (7)  Ms Amparo Arango (Inactive Vice-chairman)  Mr Alvaro Nadal (Inactive Vice-chairman)  Ms Katrina Naut (Inactive Vice-chairman) |

Notes:

1. Chairing since March 2017
2. Vice-chairing since March 2017
3. Vice-chairing since September 2017
4. Vice-chairing since May 2018
5. Chairing from March 2017 – December 2019
6. Vice-chairing from March 2017 – December 2019
7. Vice-chairing from December 2019 – June 2020
8. Chairing from December 2019 – June 2020
9. Chairing since July 2020

**2.2 Questions and Rapporteurs**

**2.2.1** WTSA-16 assigned to Study Group 20 the following seven (7) Questions listed in Table 4a and SG20 appointed the listed Rapporteurs and Associate Rapporteurs through this study period. TSAG during its meeting held from 11 to 18 January 2021, endorsed a new set of Questions for SG20 listed in Table 4b.

**2.2.2** The Questions listed in Table 5 have been adopted during this period.

**2.2.3** The Questions listed in Table 6 have been deleted during this period.

**TABLE 4a  
Study Group 20 – Questions assigned by WTSA-16 and Rapporteurs**

|  |  |  |  |
| --- | --- | --- | --- |
| **Questions** | **Title of the Questions** | **WP** | **Rapporteur** |
| Q1/20 | End to end connectivity, networks, interoperability, infrastructures and Big Data aspects related to IoT and SC&C | WP1/20 | Mr Lee Jun Seob (Rapporteur) (1) Ms Almunifi Aysha (Associate rapporteur) (1) Mr Ma Chao (Associate rapporteur) (1) Mr Roussos Georges (Associate rapporteur) (1) |
| Q2/20 | Requirements, capabilities, and use cases across verticals | WP1/20 | Mr Carugi Marco (Rapporteur) (1) Mr Abbassene Ali (Associate rapporteur) (1) Ms Jia Xueqin (Associate rapporteur) (1) Mr Martín Juan Pablo (Associate rapporteur) (1) |
| Q3/20 | Architectures, management, protocols and Quality of Service | WP1/20 | Ms He Shane (Rapporteur) (1) Mr Abdalla Ahmed (Associate rapporteur) (1) Ms Bi Jiayu (Associate rapporteur) (3) Mr El Sakka Mohanad (Associate rapporteur) (1) Mr Luo Song (Associate rapporteur) (1) |
| Q4/20 | e/Smart services, applications and supporting platforms | WP1/20 | Mr Lee Gyu Myoung (Rapporteur) (1) Mr Anthopoulos Leonidas (Associate rapporteur) (4) (5)  Mrs Huang Zheng (Associate rapporteur) (1)  Mr KimSunghan (Associate rapporteur) (5) Mr Pérez Ricardo (Associate rapporteur) (1) Mr Tao Menghua (Associate rapporteur) (2) |
| Q5/20 | Research and emerging technologies, terminology and definitions | WP2/20 | Mr Ziegler Sébastien (Rapporteur) (1) Mr Angelopoulos Marios (Associate rapporteur) (3) Mr Chen Nengcheng (Associate rapporteur) (1) Mr Mutiso Alex (Associate rapporteur) (1)  Mr Quesada Rodriguez Adrian (Associate rapporteur) (5) |
| Q6/20 | Security, privacy, trust and identification for IoT and SC&C | WP2/20 | Mr AbouAlmal Abdulhadi (Rapporteur) (1) Ms Bahri Assia (Associate rapporteur) (1) Mr Jia Xiongwei (Associate rapporteur) (1) Mr Rosli Adil Hidayat (Associate rapporteur) (1) |
| Q7/20 | Evaluation and assessment of Smart Sustainable Cities and Communities | WP2/20 | Mr Geray Okan (Co-rapporteur) (1) Mr Li Keng (Co-rapporteur) (1) Mr Azhar Ahmad Helmi (Associate rapporteur) (1) |

**TABLE 4b  
Study Group 20 – Questions assigned by TSAG (11-18 January 2021) and Rapporteurs**

|  |  |  |  |
| --- | --- | --- | --- |
| **Questions** | **Title of the Questions** | **WP** | **Rapporteur** |
| Q1/20 | Interoperability and interworking of IoT and SC&C applications and services | WP1/20 | Mr Lee Jun Seob (Rapporteur) (1) Ms Almunifi Aysha (Associate rapporteur) (1) Mr Ma Chao (Associate rapporteur) (1) Mr Roussos Georges (Associate rapporteur) (1) |
| Q2/20 | Requirements, capabilities and architectural frameworks across verticals enhanced by emerging digital technologies | WP1/20 | Mr Carugi Marco (Rapporteur) (1) Mr Abbassene Ali (Associate rapporteur) (1) Ms Jia Xueqin (Associate rapporteur) (1) Mr Martín Juan Pablo (Associate rapporteur) (1) |
| Q3/20 | IoT and SC&C architectures, protocols and QoS/QoE | WP1/20 | Ms He Shane (Rapporteur) (1) Mr Abdalla Ahmed (Associate rapporteur) (1) Ms Bi Jiayu (Associate rapporteur) (3) Mr El Sakka Mohanad (Associate rapporteur) (1) Mr Luo Song (Associate rapporteur) (1) |
| Q4/20 | Data analytics, sharing, processing and management, including big data aspects, of IoT and SC&C | WP1/20 | Mr Lee Gyu Myoung (Rapporteur) (1) Mr Anthopoulos Leonidas (Associate rapporteur) (4) (5)  Mrs Huang Zheng (Associate rapporteur) (1)  Mr KimSunghan (Associate rapporteur) (5) Mr Pérez Ricardo (Associate rapporteur) (1) Mr Tao Menghua (Associate rapporteur) (2) |
| Q5/20 | Study of emerging digital technologies, terminology and definitions | WP2/20 | Mr Ziegler Sébastien (Rapporteur) (1) Mr Angelopoulos Marios (Associate rapporteur) (3) Mr Chen Nengcheng (Associate rapporteur) (1) Mr Mutiso Alex (Associate rapporteur) (1)  Mr Quesada Rodriguez Adrian (Associate rapporteur) (5) |
| Q6/20 | Security, privacy, trust and identification for IoT and SC&C | WP2/20 | Mr AbouAlmal Abdulhadi (Rapporteur) (1) Ms Bahri Assia (Associate rapporteur) (1) Mr Jia Xiongwei (Associate rapporteur) (1) Mr Rosli Adil Hidayat (Associate rapporteur) (1) |
| Q7/20 | Evaluation and assessment of Smart Sustainable Cities and Communities | WP2/20 | Mr Geray Okan (Co-rapporteur) (1) Mr Li Keng (Co-rapporteur) (1) Mr Azhar Ahmad Helmi (Associate rapporteur) (1) |

Notes:

1. Appointed March 2017
2. Appointed September 2017
3. Appointed December 2018
4. Appointed April 2019 as Q5/20 Co-rapporteur
5. Appointed May 2021

**TABLE 5  
Study Group 20 – New Questions adopted and Rapporteurs**

| **Questions** | **Title of the Questions** | **WP** | **Rapporteur** |
| --- | --- | --- | --- |
| None. |  |  |  |

**TABLE 6  
Study Group 20 – Questions deleted**

| **Questions** | **Title of Questions** | **Rapporteurs** | **Results** |
| --- | --- | --- | --- |
| None |  |  |  |

# 3 Results of the work accomplished during the 2017-2021 study period

**3.1 General**

During the study period, Study Group 20 examined 987 Contributions and generated a large number of TDs and liaison statements. It also:

– drew up 98 new Recommendations;

– amended/ revised 1 existing Recommendations;

– developed 15 Supplements; and

– produced 6 informative texts.

**3.2 Highlights of achievements**

The main results achieved on the various Questions assigned to Study Group 20 are briefly summarized below. Formal replies to the Questions are given in a synoptic table in Annex 1 of this report.

**a) Q1/20, Interoperability and interworking of IoT and SC&C applications and services**

Question 1/20 studies the use of ICT infrastructure and relevant models such as implementation and deployment models, to ensure end to end connectivity and service management. Tasks of Q1/20 include:

Developing Recommendations, Reports, Guidelines, etc. as appropriate on:

* ICT and physical infrastructures to deliver IoT and SC&C e/Smart services including, but not limited to, mobile and fixed telecom networks, pipelines, intelligent building system, information and traffic systems, Big Data systems and other facilities;
* Models for use and implementation of ICT infrastructure for IoT and SC&C;
* Best practices for efficient and cost-effective deployment of ICT networks and infrastructure for IoT & SC&C;
* Interoperability and integration across IoT and SC&C verticals and technologies;
* End to end connectivity and interoperability of IoT systems and devices for enabling delivery of IoT and SC&C e/Smart services;
* Technical, syntax and semantic aspects of IoT interoperability as well as middleware and platforms for interoperability of IoT applications and services;
* Data sets and formats to enable data interoperability among various verticals;
* IoT and SC&C Big Data overview, requirements and ecosystems, including developing standardized efficient systems for data analytics, distributed data computation, real time Big Data encryption;

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

In this study period, Q1/20 has developed 4 new Recommendations and 2 new Supplements:

* ITU-T Y.4200 “Requirements for interoperability of smart city platforms”, defines the requirements for interoperability of a smart city platform (SCP) and reference points in order to ensure the correct functioning of the city services. The SCP offers services to a smart city. Interoperability between SCPs allows the increase in number of services and their quality. It enables the provision of better services to citizens, and at the same time ensures maximum efficiency, scalability and simple integration. By permitting interoperability with other platforms, the SCP will also encourage local economic development through innovation and competition.
* ITU-T Y.4201 “High-level requirements and reference framework of smart city platform”, presents the high-level requirements and reference framework of smart city platform (SCP). The SCP is a fundamental platform supporting all the services and applications of a smart city, with the objective to improve quality of life, provide urban operation and services for the benefit of the citizens while ensuring city sustainability. These high-level requirements include comprehensive and updated repositories of city information, infrastructure life-cycle management, inter-system communication, security support, maintenance support, controls of processer, decision making support, real-time dissemination of public information, resiliency, and interoperability. This Recommendation benefits the plan, design, construction, deployment, operation and maintenance of smart cities and communities.
* ITU-T Y.4461 “Framework of open data in smart cities”, defines a framework of open data in smart cities. It clarifies the concept of open data in smart cities, analyses the benefits of open data in smart cities, identifies the key phases, key roles and activities of open data in smart cities and describes the framework and general requirements of open data in smart cities. The use cases are also provided in an informative appendix.
* ITU-T Y.4477 “Framework of service interworking with device discovery and management in heterogeneous Internet of things environments”, specifies a framework of service interworking with device discovery and management in heterogeneous Internet of things (IoT) environments.
* ITU-T Y.Suppl.45 to ITU-T Y.4000 series “An overview of smart cities and communities and the role of information and communication technologies”, provides an overview of roles of Information and Communication Technologies (ICTs) in Smart Sustainable Cities (SSC) primarily based on ITU-T Recommendations. An SSC aims to improve quality of life, efficiency of urban operation and services, and competitiveness, ensuring that needs of present and future generations with respect to economic, social, environmental as well as cultural aspects of cities and communities are met. Smart sustainable cities in general, share the end goal of achieving an economically sustainable urban environment without sacrificing on the quality of life (QoL) of their citizenry. A smart city and community strives to create a sustainable living environment for citizens using the Internet of things (IoT), enabled by information communication technologies (ICTs). An IoT-based infrastructure, enabled using ICTs, can continue to play a pivotal role in smart sustainable cities by functioning as a platform for the aggregation of information and data that can help government officials and citizens understand how the city is functioning in terms of resource consumption and services.
* ITU-T Y.Suppl.58 “Internet of Things and smart cities and communities standards roadmap”, presents the Joint Coordination Activity on Internet of Things and Smart Cities and Communities (JCA-IoT and SC&C) roadmap which contains a collection of standards and ITU-T Recommendations related to Internet of Things (IoT), smart cities and communities (SC&C), network aspects of identification systems, including RFID (NID) and ubiquitous sensor networks (USN).

**b) Q2/20, Requirements, capabilities and architectural frameworks across verticals enhanced by emerging digital technologies**

Question 2/20 addresses the support of emerging services and applications for IoT and SC&C, with consideration of the different verticals. On the basis of use cases and related ecosystem aspects, the requirements and capabilities imposed on IoT will be specified. Tasks of Q2/20 include:

Developing Recommendations Reports, Guidelines etc. as appropriate for the support of emerging services and applications for IoT and SC&C, covering:

* different verticals;
* use cases of IoT and SC&C services and applications;
* ecosystem aspects taking into account business models and use cases;
* requirements for IoT and SC&C services and applications (including for the different service interfaces that will be required);
* capabilities imposed on the IoT (including capability frameworks and capabilities for both network and user domains);

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

In this study period, Q2/20 has developed 24 new Recommendations, revised 1 Recommendations and 3 new Supplements:

* ITU-T Y.4003 “Overview of smart manufacturing in the context of the industrial Internet of things”, provides an overview of smart manufacturing in the context of the Industrial Internet of things (IIoT). The Recommendation introduces at first smart manufacturing and IIoT, including the smart manufacturing capabilities with respect to the Internet of things (IoT) reference model [ITU-T Y.4000]. Then, with respect to smart manufacturing in the context of the IIoT, it identifies fundamental system characteristics and high-level requirements, specifies a reference model and provides some use cases.
* ITU-T Y.4114 “Specific requirements and capabilities of the IoT for Big Data”, complements the developments on common requirements of the IoT [ITU-T Y.2066] and functional framework of the IoT [ITU-T Y.2068] in terms of the specific requirements and capabilities that the IoT is expected to support in order to address the challenges related to Big Data. Also, it constitutes a basis for further standardization work (e.g. functional entities, APIs and protocols) concerning Big Data in the IoT.
* ITU-T Y.4116 “Requirements of transportation safety service including use cases and service scenarios”, describes requirements for providing transportation safety services. The use cases and related service scenarios which are used to extract requirements for various IoT services and applications are also described in this Recommendation.
* ITU-T Y.4117 “Requirements and capabilities of Internet of Things for support of wearable devices and related services”, describe characteristics, specific requirements and capabilities of the IoT for support of Wearable Device Services. From an IoT requirement perspective, the Wearable Device Services are classified in this Recommendation in four main categories: wearable device related multimedia services (WDMS), wearable device related health management services (WDHS), wearable device related sport services (WDSS) and wearable device related assistant services (WDAS). Wearable devices can be categorized according to their usage (WDS class). Specific requirements and capabilities of the IoT for support of different WDS and related wearable devices are described in detail. Furthermore, information concerning relevant use cases for wearable devices and related services is provided in appendix. Further information about the categorization of wearable devices and related services is provided in the appendix.
* ITU-T Y.4118 “Internet of Things requirements and technical capabilities for support of accounting and charging”, provides accounting and charging requirements for IoT as well as an IoT accounting and charging technical capability framework, in order to assist in the standardization of accounting and charging technical mechanisms for IoT and to facilitate the development of the IoT market. The Recommendation focuses on the network layer capabilities and service support and application support layer capabilities, as well as business use cases applied to IoT. The use cases, requirements and technical capability framework provided in this Recommendation are from a technical point view.
* ITU-T Y.4119 “Requirements and capability framework for IoT-based automotive emergency response system”, provides an overview of an IoT-based automotive emergency response system (AERS), identifies requirements of the AERS for aftermarket devices, and provides a capability framework of the AERS.
* ITU-T Y.4120 “Requirements of Internet of things applications for smart retail stores”, provides requirements of IoT applications for smart retail stores.
* ITU-T Y.4121 “Requirements of an Internet of Things enabled network for support of applications for global processes of the Earth”, describes key IoT GP features, deployment schemes of IoT GP devices and requirements of the IoT GP network.
* ITU-T Y.4122 “Requirements and capability framework of edge computing-enabled gateway in the IoT”, provides additional capabilities and capability framework of the edge computing-enabled gateway in the IoT are specified. Examples of applicability of the edge computing-enabled gateway in the IoT are also given.
* ITU-T Y.4123 “Requirements and capability framework of smart shopping mall system”, specifies requirements and capability framework of smart shopping mall system.
* ITU-T Y.4202 “Framework of wireless power transmission application service”, defines a framework for WPT application service by describing concept, functional model, requirements, basic service flows and use cases.
* ITU-T Y.4203 “Requirements of things description in the Internet of things”, specify requirements for an effective way of representing things as far as possible in a homogeneous way. The focus of the document is on the following two concerns of things description. " Representing physical things as virtual things to map the physical things into information world; " Representing the relationship of virtual things to reflect the relationship of the represented physical things The corresponding requirements of things description in the IoT are specified, including: " High level requirements of things description in IoT " Requirements on the characterization aspects of things description in IoT This Recommendation may be relevant for the matters addressed by ITU-T Y.4114 "Specific requirements and capabilities of the Internet of things for big data", e.g. semantic related data processing.
* ITU-T Y.4204 “Accessibility requirements for the Internet of things applications and services”, provides accessibility requirements specific to Internet of Things (IoT) applications and services. Benefits of accessible IoT applications and services are addressed, and accessibility requirements for IoT applications and services for persons with disabilities, persons with age related disabilities and those with specific needs to utilize the benefits of IoT applications and services, are specified. Some use cases are also provided in the Appendix to illustrate the need for IoT accessibility. This Recommendation complements existing Recommendations specifically defined for certain platforms in case such platforms are applied in the IoT context.
* ITU-T Y.4206 “Requirements and capabilities of user-centric work space service”, provides the requirements and capabilities of UCS service. The provided requirements and capabilities are necessary to implement various types of UCS services.
* ITU-T Y.4207 “Requirements and capability framework of smart environmental monitoring”, provides the requirements and capability framework of smart environmental monitoring (SEM). As a smart application of Internet of Things (IoT) in the field of environmental monitoring and protection, SEM is an important means to enhance environmental management level and develop environmental protection. The provided requirements and capability framework are intended to be generally applicable in environmental monitoring.
* ITU-T Y.4208 “IoT requirements for support of edge computing”, provides an overview on related challenges faced by the IoT and describes how the IoT supporting edge computing may address these challenges. From the edge computing deployment perspective, service requirements for support of edge computing capabilities in the IoT are identified as well as related functional requirements. As example, scenarios of edge computing deployment in different application domains, edge computing scenarios for Vehicle-to-Everything and for smart manufacturing are provided in Appendix I.
* ITU-T Y.4209 “Requirements for interoperation of the smart port with the smart city”, provides the requirements for Smart Port interoperation with Smart Cities and other smart elements. Additionally, these requirements are the foundation that enables the provision of enhanced smart services by the Smart Port (which may also benefit Smart Cities), also described in this Recommendation.
* ITU-T Y.4210 “Requirements and use cases for universal communication module of mobile IoT devices”, as an important part of mobile IoT devices, the universal communication module is a key component to achieve economies of scale for mobile IoT devices, accelerate the progress of research and development, and promote the application of new mobile IoT technologies. This Recommendation specifies requirements for universal communication module of mobile IoT devices. Related use cases are provided in Appendix I, universal communication module reference types are described in Appendix II.
* ITU-T Y.4211 “Accessibility requirements for smart public transportation services”, specifies accessibility requirements for smart public transportation services.
* ITU-T Y.4212 “Requirements and capabilities of network connectivity management in the Internet of things”, specifies the requirements and capabilities of network connectivity management in the Internet of Things (IoT). The specified requirements and capabilities are intended to be generally applicable in network connectivity management application scenarios.
* ITU-T Y.4213 “IoT requirements and capability framework for monitoring physical city assets”, identifies specific IoT requirements for monitoring physical city assets in smart cities.
* ITU-T Y.4214 “Requirements of IoT-based civil engineering infrastructure health monitoring system”, describes the requirements specific to the IoT-based civil engineering infrastructure health monitoring system for the purpose of maintaining civil engineering infrastructures.
* ITU-T Y.4215 “Use cases, requirements and capabilities of unmanned aircraft systems for the Internet of Things”, describes the use cases, requirements and capabilities of unmanned aircraft systems (UASs) for the Internet of things (IoT).
* ITU-T Y.4101/Y.2067 (revised) “Common requirements and capabilities of a gateway for Internet of Things applications”, provides the common requirements and capabilities of a gateway for Internet of things (IoT) applications. The provided common requirements and capabilities are intended to be generally applicable in gateway application scenarios. The scope of this Recommendation includes: o General characteristics of a gateway for IoT applications o Common requirements of a gateway for IoT applications o Common capabilities of a gateway for IoT applications Use cases of a gateway for IoT applications are provided in appendixes.
* ITU-T Y.4419 “Requirements and Capability Framework of Smart Utility Metering (SUM)”, specifies requirements and capabilities for the support for smart utility metering (SUM). Smart Utility Metering (SUM) can provide remote data collection for utility metering, device maintenance in real time and can support a variety of applications.
* ITU-T Y.Sup.53 to Y.4000 series “IoT use cases”, provides a set of Use Cases related to different application domains of the IoT.
* ITU-T Y.Suppl.56 “Use cases of smart cities and communities”, provides a set of use cases related to Smart Cities and Communities (SC&C). The SC&C use cases described in this Supplement are in pilot or commercial phase. The use case collection is expected to provide useful information for the definition of common requirements of SC&C and for other future studies on SC&C. It is also expected this information will benefit the study of the relationship between city scales and SC&C solutions, and will provide examples of the social and economic benefits. The use cases in this Supplement may also help to plan the deployment of similar smart city solutions in other cities.
* ITU-T Y.Suppl.68 “Framework for Internet of Things ecosystem Master Plan”, describes a framework to support Member States to define their IoT ecosystem Master Plan, based on vertical domain assessment and identification of technical aspects to support the selected verticals. It also presents some actions to support the Master Plan deployment.

**c) Q3/20, IoT and SC&C architectures, protocols and QoS/QoE**

Question 3/20 addresses IoT functional architectures, protocols, management mechanisms, and QoS (including performance) of IoT and Smart Sustainable Cities and Communities (SC&C). Tasks of Q3/20 include:

Developing Recommendations, Reports, Guidelines, etc. as appropriate on:

* Conducting studies on general reference models on IoT and vertical industry needs;
* Developing frameworks to identify the basic architectural compositions and views on IoT. These will be based on the identification of architectural requirements derived from the industry needs;
* Identifying entities, their functions, and reference points required to provide support to IoT applications and services;
* Determining the requirements that the connectivities 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 connectivities, management mechanisms and protocols available from ITU-T and other SDOs;
* Developing modifications and enhancements to the signalling requirements, connectivity technologies, management mechanisms and protocols that will enable them to meet the IoT requirements and architecture;
* Identifying performance requirements of connectivity technologies that will enable them to meet the IoT requirements;
* Identifying mechanisms for achieving QoS and its measurement principles required for IoT and SC&C;
* Identifying interfaces for which interoperability between different IoT network elements is desirable and for which detailed requirements need to be studied and control protocols need to be standardized;
* Defining interworking with legacy systems;
* Studying specific IoT signalling requirements and protocols such as peer-to-peer and mesh architectures;
* Developing intelligence control related technologies that will provide support to IoT applications and services for various verticals and systems;
* Identifying mechanisms for achieving architectural interoperability for IoT and SC&C;

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

In this study period, Q3/20 has developed 33 new Recommendations and 6 new Technical Reports:

* ITU-T Y.4115 “Reference architecture for IoT device capabilities exposure”, specifies reference architecture of IoT device capability exposure (IoT DCE) which supports IoT applications in DCE devices (e.g., smart phones, tablets and home gateways) to access device capabilities exposed by IoT devices connected to the DCE device. This Recommendation clarifies the concept of the IoT DCE, identifies its general characteristics and common requirements and provides the reference architecture for the IoT DCE and relevant high-level common procedures.
* ITU-T Y.4416 “Architecture of the Internet of things based on next generation network evolution”, provides a description of the architecture of the Internet of Things (IoT) based on Next Generation Network evolution (NGNe), taking into account of the IoT reference model specified in Recommendation ITU-T Y.2060, the IoT common requirements specified in Recommendations ITU-T Y.2066, and the IoT functional framework and capabilities specified in Recommendation ITU-T Y.2068. It describes extensions to NGNe functional entities, reference points and IoT components, and enhancement to NGNe capabilities as described in ITU-T Y.2012, and other related Recommendations in order to support of the IoT.
* ITU-T Y.4417 “Framework of self-organization network in the IoT environments”, specifies a framework of self-organization networking for IoT in an aspect of communications. For doing this, this Recommendation presents the concepts, characteristics, architectures, requirements, and functionalities of self-organization networking.
* ITU-T Y.4418 “Functional architecture of gateway for Internet of things applications”, studies the functional architecture of gateway for IoT applications, including the gateway's functional entities and relevant reference points.
* ITU-T Y.4421 “Functional architecture for unmanned aerial vehicles and unmanned aerial vehicle controllers using IMT-2020 networks”, provides a functional architecture for UAVs and UAV controllers using IMT-2020 networks and functionalities defined in the application layer, service and application support layer, and security capabilities. The motivation of this Recommendation is to solve the issues of civilian UAVs accessing and communicating in IMT-2020 networks using its transmission capabilities.
* ITU-T Y.4455 “Reference architecture for IoT network service capability exposure”, clarifies the concept of the IoT NCE, identifies its general characteristics and common requirements, and provides the reference architecture and relevant capabilities for the IoT NCE.
* ITU-T Y.4460 “Architectural reference models of devices for IoT applications”, describes the architectural reference models of devices for IoT applications, based on a classification of devices defined by processing power and communication capabilities. The architectural reference models described also includes the device's functional entities and the functional entities interaction for each device's architectural reference model. Note: Devices with no processing capabilities are also not considered on this Recommendation because they are simple devices (ID Tags) that were defined on ITU-T Y.2213.
* ITU-T Y.4462 “Requirements and functional architecture of open IoT identity correlation service”, specifies the reference architecture of open IoT ICS which supports Internet of things (IoT) devices to access multiple third-party service providers. This Recommendation clarifies the concept of the open IoT ICS, identifies its basic capabilities, common requirements and also provides the reference architecture and relevant high-level common procedures for open IoT ICS.
* ITU-T Y.4467 “Minimum set of data structure for automotive emergency response system”, specifies an MSD structure and encoding rule for an automotive emergency response system (AERS).
* ITU-T Y.4468 “Minimum set of data transfer protocol for automotive emergency response system”, specifies an MSD transfer protocol to provide the rules of an MSD transfer operations between an automotive emergency detection device (AEDD) and an automotive emergency response center (AERC) in an automotive emergency response system (AERS).
* ITU-T Y.4469 “Reference architecture of spare computational capability exposure of IoT devices for smart home”, introduces spare computational capability exposure (SCCE) of Internet of things (IoT) devices for smart home and provides the characteristics and reference architecture of SCCE. In addition, it provides common procedures and several use cases to illustrate the concepts and the reference architecture of SCCE.

SCCE is a functional entity in the smart home that facilitates IoT applications to make full use of spare computational capabilities of IoT devices in smart home scenarios. SCCE collects the spare computational capabilities exposed by IoT devices and provides them to IoT applications. With using SCCE, the spare computational capabilities of IoT devices can be used by IoT applications instead of the cloud to reduce the requirements of cloud computing and network resources.

* ITU-T Y.4470 “Reference architecture of artificial intelligence service exposure for smart sustainable cities”, introduces artificial intelligence service exposure (AISE) for smart sustainable cities (SSC), and provides the common characteristics and high-level requirements, reference architecture and relevant common capabilities of AISE.

AISE is one of the basic supporting functional entities for smart sustainable cities, with which SSC services can use uniform reference points (exposed by AISE) to integrate and access the AI capabilities of AI services (e.g., machine learning services for image recognition, natural language processing services, traffic prediction services etc.). In addition, AISE can collect and open SSC data, and it supports AI services to train and perform AI capabilities in AISE in SSCs.

* ITU-T Y.4471 “Functional architecture of network-based driving assistance for autonomous vehicles”, defines a reference functional architecture of network-based driving assistance (NDA) for autonomous vehicles. It clarifies the concept of NDA, specifies key functional entities and defines reference points between entities. The use cases and operational procedures are also provided in an informative appendix. For improvement in the driving of autonomous vehicles, coordination between vehicles and infrastructures need to be improved with network technologies to provide the increasing transportation services and application requirements. NDA can improve the safety and efficiency of automated driving with capabilities of cooperative perception and decisions.
* ITU-T Y.4476 “OID-based resolution framework for transactions of a distributed ledger assigned to IoT resources”, specifies a resolution framework for the transactions of a distributed ledger assigned to IoT resources. This Recommendation also describes the concepts, functional requirements, architecture and procedures of an OID-based resolution framework by using DLT.
* ITU-T Y.4478 “Requirements and functional architecture for smart construction site services”, introduces requirements and functional architecture for smart construction site (SCS) services with a concept, its goals and key components.
* ITU-T Y.4480 “Low power protocol for wide area wireless networks”, describes a protocol for wide area wireless networks, which is optimized for battery-powered end-devices that may be either mobile or mounted at a fixed location.
* ITU-T Y.4500.1 “oneM2M- Functional Architecture”, harmonizes and specifies the end-to-end oneM2M functional architecture in the M2M Service Layer.
* ITU-T Y.4500.2 “oneM2M- Requirements”, provides an informative functional role model and normative technical requirements for oneM2M.
* ITU-T Y.4500.4 “oneM2M- Service Layer Core Protocol Specification”, specifies the communication protocol(s) for oneM2M compliant Systems, M2M Applications, and/or other M2M systems. The Recommendation also specifies the common data formats, interfaces and message sequences to support reference points(s) defined by oneM2M.
* ITU-T Y.4500.5 “oneM2M- Management enablement (OMA)”, specifies the usage of OMA DM and OMA LwM2M resources and the corresponding message flows including normal cases as well as error cases to fulfil the oneM2M management requirements.
* ITU-T Y.4500.6 “oneM2M Management enablement (BBF)”, specifies the usage of the BBF TR-069 protocol and the corresponding message flows including normal cases as well as error cases to fulfil the oneM2M management requirements. " Protocol mapping between the oneM2M service layer and BBF TR-069 protocol. The Mca reference point, ms interface and la interface are possibly involved in this protocol mapping. " Mapping between the oneM2M management related resources and the TR-069 protocol RPCs and TR-181i2 data model. Specification of new TR-181 data model elements to fulfil oneM2M specific management requirements that cannot be currently translated
* ITU-T Y.4500.8 “oneM2M- CoAP Protocol Binding”, covers the protocol specific part of communication protocol used by oneM2M compliant systems as 'CoAP binding'
* ITU-T Y.4500.9 “oneM2M- HTTP Protocol Binding”, specifies the protocol specific part of communication protocol used by oneM2M compliant systems as RESTful HTTP binding. The scope of the present document is (not limited to as shown below): " Binding oneM2M Protocol primitive types to HTTP method. " Binding oneM2M response status codes (successful/unsuccessful) to HTTP response codes. " Binding oneM2M RESTful resources to HTTP resources.
* ITU-T Y.4500.10 “oneM2M- MQTT Protocol Binding”, specifies the binding of Mca and Mcc primitives (message flows), defined in the Service Layer Core Protocol, onto the MQTT transport protocol.
* ITU-T Y.4500.11 “oneM2M- Common Terminology”, contains a collection of specialist technical terms, definitions and abbreviations referenced within the oneM2M specifications.
* ITU-T Y.4500.12 “oneM2M Base Ontology”, contains provides normative and informative specifications for the oneM2M Base Ontology and its instantiation into oneM2M resources.
* ITU-T Y.4500.13 “oneM2M- Interoperability Testing”, provides a full set of Interoperability Test Descriptions. The purpose of the interoperability testing is to prove end-to-end functionality between Application Entities and Common Service Entities over the Mca and Mcc reference points. The testing is intended to address the access to resources on local CSE and/or remote CSE.
* ITU-T Y.4500.14 “oneM2M- LwM2M Interworking”, specifies the interworking capabilities of the M2M Service Layer between ASN/IN/MN CSEs and LWM2M Endpoints.
* ITU-T Y.4500.15 “oneM2M- Testing framework”, provides methodology for development of conformance and interoperability test strategies, test systems and the resulting test specifications for oneM2M standards.
* ITU-T Y.4500.20 “oneM2M- WebSocket Protocol Binding”, specifies the binding of Mca and Mcc primitives onto the WebSocket binding. It specifies: " Procedures and message formats for operating and closing of WebSocket connections. " How request and response primitives are mapped into the payload of the WebSocket protocol.
* ITU-T Y.4500.22 “oneM2M- Field Device Configuration”, specifies the architectural options, resources and procedures needed to provision and maintain devices in the Field Domain in order to establish M2M Service Layer operation.
* ITU-T Y.4500.23 “oneM2M-Home Appliances Information Model and Mapping”, describes the oneM2M defined information model for home appliances, including the description of how it is mapped with other information models from external organizations. It also explains the ontology for the home domain information model.
* ITU-T Y.4500.32 “oneM2M- MAF and MEF Interface Specification”, specifies communication between the M2M Authentication Function (MAF) and MAF clients on the reference point Mmaf, and between the M2M Enrolment Function (MEF) and MEF clients on the reference point Mmef.
* ITU-T Y.oneM2M.DG.AppDev “oneM2M- Application developer guide: Light control example using HTTP binding”, provides a simple use case for guiding application developers to develop applications using functionalities provided by a oneM2M service platform, which is a part of oneM2M developer guidance series.
* ITU-T Y.oneM2M.DG.CoAP “oneM2M Developer Guide of CoAP binding and long polling for temperature monitoring”, provides a simple use case for guiding application developers to develop applications using functionalities provided by a oneM2M service platform, which is a part of oneM2M developer guidance series.
* ITU-T Y.oneM2M.DG.DM “oneM2M- Developer guide of device management”, provides developer guide for device management using oneM2M.
* ITU-T Y.oneM2M.Ind.DE “oneM2M Industrial Domain Enablement”, collects the use cases of the industrial domain and the requirements needed to support the use cases collectively. Furthermore, the Technical Report also identifies necessary technical work needing to be addressed while enhancing future oneM2M specifications.
* ITU-T Y.oneM2M.DG.SEM “oneM2M-Developer Guide of Implementing semantics”, describes how developers can quickly implement applications using the semantic functionality of oneM2M release 2.
* ITU-T Y.oneM2M.UCC “oneM2M Use Case Collection”, provides a collection of use cases from a variety of M2M industry segments.

**d) Q4/20,** **Data analytics, sharing, processing and management, including big data aspects, of IoT and SC&C**

Question 4/20 focuses on e/smart services and applications aspects related to the verticals, to facilitate seamless e/smart services among heterogeneous IoT environments. Tasks of Q4/20 include:

Developing Recommendations, Reports, Guidelines, etc. as appropriate on:

* e/Smart services and applications platforms for IoT and SC&C;
* SC&C applications and services including, inter alia, smart grid, water, mobility, logistic, waste, healthcare, e-government, emergency telecommunications, education, transport, utilities, finance, etc.;
* Functionality profiles of e/smart applications and services;
* Information modelling relevant to e/smart services and applications;
* Middleware for e/smart services and applications including SC&C;
* APIs, Web interfaces among IoT middleware entities;
* Context modelling languages for context awareness of IoT middleware;
* Context/event management and reasoning for cognitive action to facilitate context aware and cognitive services considering social relationships among human and things;
* Autonomic service management for e/smart services and applications including SC&C;
* Business support capabilities like service activation, enrolment, contract management, billing and troubleshooting for e/smart services and applications including SC&C;

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

In this study period, Q4/20 has developed 20 new Recommendations and 3 new Supplement. Recommendations:

* ITU-T Y.4415 “Architecture of web of objects based virtual home network”, covers the architecture of WoO based VHN (WVHN) in accordance with [TU-T H.622.2] and [ITU-T Y.4452].
* ITU-T Y.4420 “Framework of IoT based monitoring and management for Lift”, describes a framework of IoT based monitoring and management for lift with a protocol and data model to solve these problems.
* ITU-T Y.4456 “Requirements and Functional Architecture for Smart Parking Lot in Smart City”, specifies requirements and functional architecture for Smart Parking Lot.
* ITU-T Y.4457 “Architectural framework for transportation safety services”, describes a transportation safety management model and an architectural framework for transportation safety services based on the IoT reference model.
* ITU-T Y.4458 “Requirements and functional architecture of smart street light service”, specifies requirements, reference architecture and related core functions of SSL Service. Related use cases are provided in Appendix I.
* ITU-T Y.4463 “Framework of delegation service for IoT devices”, describes overview and types of the delegation service in IoT environment. It also describes the requirements and architectural models of the delegation service.
* ITU-T Y.4464 “Framework of blockchain of things as decentralized service platform”, introduces a decentralized IoT service platform, blockchain of things (BoT), which is enabled by blockchain-related technologies. This Recommendation analyses the concept, common characteristics and high-level requirements of BoT, and provides common capabilities and functionalities, general procedures, and relevant use cases for BoT. BoT, works in a decentralized service mode and is capable of enhancing many aspects of IoT. It has the advantages of blockchain-related technologies, especially for building decentralized data storage and management, crowding decision-making and automatic interactions.
* ITU-T Y.4465 “Framework of IoT Services based on Visible Light Communications”, describes a framework of Internet-of-Things (IoT) services based on Visible Light Communications (VLC). After describing the technical overview of VLC and the concepts of IoT services based on VLC, this Recommendation describes requirements and a reference model.
* ITU-T Y.4466 “Framework of smart greenhouse service”, specifies requirements, a reference model, a functional architecture and interfaces for a smart greenhouse service.
* ITU-T Y.4473 “SensorThings API - Sensing”, specifies the SensorThings application programming interface (API) which provides an open standard-based and geospatial-enabled framework to interconnect Internet of things (IoT) devices, data, and applications over the Web.

The SensorThings API is an open standard, and that means it is non-proprietary, platform-independent. It builds on a rich set of proven-working and widely-adopted open standards, such as the Web protocols and the Open Geospatial Consortium (OGC) sensor Web enablement (SWE) standards, including the ISO/OGC observation and measurement data model. The SensorThings API is extensible and can be applied to not only simple but also complex use cases.

This Recommendation provides a standard way to manage and retrieve observations and metadata from heterogeneous IoT sensor systems. The SensorThings API uses representational state transfer (REST) principles, an efficient JavaScript object notation (JSON) encoding, message queuing telemetry transport (MQTT) protocol, flexible OASIS open data protocol (OData) and uniform resource locator (URL) conventions.

* ITU-T Y.4474 “Functional architecture for IoT services based on Visible Light Communications”, describes the functional architecture for Internet of Things (IoT) services based on Visible Light Communications (VLC), which includes functional requirements, functional architecture, messages and information flows.
* ITU-T Y.4475 “Lightweight intelligent software framework for IoT devices”, addresses the concept of the lightweight intelligent software framework (LISF) which supports IoT applications requiring intelligent processing, and enables it working on resource-limited IoT devices. It identifies general requirements and provides a functional architecture of LISF based on the IoT reference model [ITU-T Y.4000].
* ITU-T Y.4555 “Service functionalities of self-quantification over Internet of things”, describes service functionalities of self-quantification over Internet of things. It clarifies the concept of self-quantification services, identifies their considerations, and specifies their requirements and functionalities.
* ITU-T Y.4556 “Requirements and functional architecture of smart residential community”, presents the key components and specifies requirements and the functional architecture of smart residential community (SRC).
* ITU-T Y.4558 “Requirements and functional architecture of smart fire smoke detection service”. Fire smoke detection service is usually deployed in indoor environment like residential buildings, factories, shopping malls, hotels, office buildings, etc. With the development of society and economy, fire smoke detection service is playing a more and more important role in people's life, but there are some issues, including inefficient maintenance and management, non-real-time device failure detection, non-real-time fire alarms notification and poor service experience.

In order to solve the above issues, Smart Fire Smoke Detection (SFSD) service can not only detect the smoke concentration through sensors and trigger a fire alarm when it reaches a certain threshold to prevent disaster, but also send the alarm information to the cloud platform through network, thus relevant departments and personnel can be notified in time through Web/APP/SMS/Voice/Instant Message Client, etc. The SFSD service can provide many benefits, including efficient maintenance and management, real-time alarm report, real-time faults report and good service experience.

Based on these observations, this Recommendation describes requirements and functional architecture of SFSD service.

* ITU-T Y.4559 “Requirements and functional architecture of base station inspection services using unmanned aerial vehicles”, describes requirements and functional architecture of BSI services using UAVs. It focuses on how to effectively provide inspection services for the base station using BSI-dedicated UAVs (BSI-UAVs).
* ITU-T Y.4560 “Blockchain-based data exchange and sharing for supporting Internet of things and smart cities and communities”. Blockchain is an emerging technology, its most important characteristics are traceable, un-erasable, immutable, and time-stamped. It is able to efficiently ensure integrity, authenticity, and auditability for all transactions. Blockchain has important impacts and benefits for data exchange and sharing in support of Internet of things (IoT) and smart cities and communities (SC&C). In most of the IoT and SC&C scenarios, it is necessary to ensure data processing, circulation, sharing and management for all trust operations. Blockchain technologies can meet these needs.

This Recommendation specifies the requirements, functional models, a platform and deployment modes of blockchain-based data exchange and sharing for supporting IoT and SC&C.

* ITU-T Y.4561 “Blockchain-based Data Management for supporting Internet of things and smart cities and communities”. Along with the development of the Internet of things (IoT) and smart cities and communities (SC&C), various applications have different kinds of requirements for data management, and there are many challenges, especially in data representing, data processing, data service provisioning, and other aspects in a secure and effective manner. Meanwhile, blockchain as an emerging technology possesses the characteristics of trust, transparency, traceability and accountability. It has the potential capabilities to solve the existing issues in data management.

This Recommendation specifies the requirements, generic reference model, common capabilities and procedures of blockchain-based data management.

* ITU-T Y.4562 “Functions and metadata of spatiotemporal information service for smart cities”, introduces the concepts of STIS for smart cities, and specifies the functions and metadata of STIS.
* ITU-T Y.4563 “Requirements and functional model to support data interoperability in IoT environments”, specifies requirements and functional model to support data interoperability in IoT environments.
* ITU-T Y.Suppl.57 to ITU-T Y.4409 “Implementation guidelines to Recommendation ITU-T Y.4409/Y.2070”, provides the implementation guidelines to [ITU-T Y.4409]. This Supplement describes implementation based on the functional architecture for the home energy management system (HEMS) and home network services specified in [ITU-T Y.4409] with regards to the information models for the devices connected to the home network, the communications protocols and the management for the home network. This Supplement also describes implementation of connecting devices with corresponding information models.
* ITU-T Y.Suppl.62 to ITU-T Y.4000 series “Overview of blockchain for supporting Internet of things and smart cities and communities in data processing and management aspects”. Blockchain presents opportunities for disruptive innovations, which enables global businesses to conduct transactions with less friction and more trust and efficiency. Blockchain shows great promise across a wide range of business applications in many fields, including Internet of things (IoT) and sustainable smart cities and communities (SC&C). There are many benefits and challenges to addressing blockchain and IoT and SC&C together. This Supplement provides an overview of blockchain aspects related to data processing and management (DPM) for IoT and SC&C.
* ITU-T Y.Suppl.69 “Web based data model for IoT and smart city systems and services”, provides a web-based data model for Internet of things (IoT) and smart cities. More specifically, this Supplement covers the following: - Suggestions for generic considerations of data format; - Necessity for a new type of metadata for interoperability; - Necessity and importance for a common data model for bridging existing data models; - Necessity, importance, and adequacy of microdata formats for data management in web environments; - Fundamental concepts and background of current web environments and microdata formats in terms of structuring and managing data in detail; - A new category of metadata, called procedural metadata, and its basic principles.

**e) Q5/20, Study of emerging digital technologies, terminology and definitions**

Question 5/20 captures and develops definitions, to contribute to a common terminology for IoT and SC&C. This Question also contribute to the research on solutions for interoperability across different technologies (including identification) and take into account both end-user and market needs. Tasks of Q5/20 include:

Developing Recommendations, Reports, Guidelines, etc. as appropriate on:

* Developing, maintaining and enhancing the Recommendations on terminology related to IoT and SC&C;
* Maintaining and enhancing the Study Group 20 Recommendations;
* Development in collaboration with other SG20 Questions, of frameworks and roadmaps, for the harmonized and coordinated development of Internet of things (IoT), including M2M communications and ubiquitous sensor networks in ITU-T;
* Development in close cooperation with ITU-D and ITU-R Study Groups and other regional and international standards development organizations (SDOs), academia and industry fora;
* Developing guidelines, methodologies and best practices related to IoT and SC&C to help developing countries in bridging the digital gap in this field;
* Developing a global repository on IoT and SC&C to promote SG20 work results and activities, as well as listing reports and links of external organizations involved in this area;
* Conducting research and developing reports related to strategic verticals including new concepts and mechanisms;
* Harmonizing the terminology within ITU and relevant SDOs;
* Identifying emerging technologies and relevant research work on IoT and SC&C;
* Liaising and fostering cooperation with academia, research and innovation community on IoT and SC&C;
* Liaising and fostering cooperation with other SDOs and industry fora including small and medium enterprises (SMEs) on IoT and SC&C;
* Identifying in coordination with other SG20 Questions, new work areas linked to IoT and SC&C, and collaborating with relevant ITU-T SGs and other SDOs and fora, to initiate studies on those identified work areas;

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

In this study period, Q5/20 has developed 3 new Recommendations and 3 new Supplements:

* ITU-T Y.4004 “Overview of smart oceans and seas, and requirements for their ICT implementations”, provides an overview of SO&S, clarifies the high-level requirements of SO&S implementations.
* ITU-T Y.4051 “Vocabulary for smart cities and communities”, contains vocabulary applied to smart cities and communities (SC&C) works. Basically, the terms and definitions in this vocabulary are defined in published Recommendations and Supplements of ITU and published standards of other international SDOs (such as ISO and IEC, etc.). Additionally, this vocabulary also includes some new terms and definitions to meet the needs of SC&C works of ITU
* ITU-T Y.4205 “Requirements and reference model of IoT-related crowdsourced systems”, introduces the concept of Crowdsourced Systems, as well as the reference model of IoT-related Crowdsourced Systems for the support of IoT applications and services to be provided via systems employing crowdsourcing principles. It addresses IoT-related Crowdsourced Systems in terms of functional requirements, reference model as well as identifying relevant security, privacy and trust issues. In particular, the main contributions can be summarized as follows: - It identifies and provides the motivation for IoT-related Crowdsourced Systems (recent technological advancements and relevant emerging trends). - It provides definitions of terms that are central when discussing Crowdsourcing and Crowdsourced Systems, thus providing a basis of common understanding. So far, such terms have been used in layman's terms, outside a formal standardised framework; a practice which has led to ambiguity hindering further development of such systems. It is worth noting that the said definitions have been elicited via a rigorous methodology from a plethora of publications (both by academia and the industry); more information can be found in the body of the Recommendation. - It provides a high-level reference model identifying the key layers and components of Crowdsourced Systems. The model does not dictate nor indicates a specific implementation or approach for building IoT-related Crowdsourced Systems. On the contrary, it provides a nominal model that facilitates the design and development of such systems by providing a common basis of reference.
* ITU-T Y.Sup.52 to ITU-T Y.4000-series “Methodology for building digital capabilities during enterprises' digital transformation”, help enterprises to address the challenges and achieve the following during enterprise digital transformation: - Making full use of ICTs to optimise the business processes, improve organizational efficiency and strengthen the utilization of data resources; - Ensuring that ICT applications become consistent and coordinated with enterprises' strategies; - Using ICTs to build digital capabilities can increase enterprises' economic benefits.
* ITU-T Y.Sup.54 to ITU-T Y.4000-series “Framework for home environment profiles and levels of IoT systems”, establish a set of data fields which reflect consumer preferences for IoT-enabled devices in specific environments. These data fields could be incorporated into a consumer device, stored in some fashion, and used by compatible IoT devices in the home and elsewhere to automatically implement those pre-set user preferences.
* ITU-T Y.Suppl.63 to ITU-T Y.4000 series “Unlocking Internet of things with artificial intelligence”, examines how artificial intelligence could step in to bolster the intent of urban stakeholders to deploy IoT technologies and eventually transition to smart cities. The main elements examined in this Supplement are: - The various technological implementations of AI which may facilitate smart city transformations; - The role played by AI in managing the data generated within the IoT realm and urban spaces; - The main benefits of adopting AI and delving into how this technology could be leveraged to attain the Sustainable Development Goals (SDGs).

**f) Q6/20, Security, privacy, trust and identification for IoT and SC&C**

Question 6/20 studies privacy by design and security by design, which emphasize that protections be built into information technologies, business practices, systems, processes, physical design, and networked infrastructure. Tasks of Q6/20 include:

Developing Recommendations, Reports, Guidelines, etc. as appropriate on:

* Authenticity, confidentiality, integrity, non repudiation, and availability of IoT devices, systems, applications, protocols, platforms, and services;
* Security and trust provisioning in IoT both at the ICT infrastructure and future heterogeneous converged service environments;
* Security and trust provisioning in IoT services and applications for converged environments among stakeholders of different industries;
* Requirements to mitigate the risks and threats identified in IoT and SC&C systems and services;
* Utilizing security constructs in IoT systems to protect identity, privacy, and security of the system;
* Technical measures to prevent compromise, and protect the integrity and privacy of IoT systems, applications, platforms, and services;
* Technical measures needed to support the protection of privacy in SC&C applications, services, and platforms;
* Identifying the potential risks associated with the different management, administration, maintenance, and service provisioning in SC&C;
* How to mitigate risks associated with the different management, administration, maintenance, and service provisioning in SC&C;
* Supporting availability and portability of the data in IoT and SC&C platforms, systems, and services;
* The use of naming, addressing, and identification in IoT and SC&C deployments;
* Identity discovery and identity management in IoT and SC&C;

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

In this study period, Q6/20 has developed 9 new Recommendations and 1 new Supplements:

* ITU-T Y.4459 “Digital entity architecture framework for IoT interoperability”, introduces digital entity architecture and its prospective in addressing interoperability and security among IoT applications. This Recommendation defines an architecture framework for information-oriented services that makes use of existing infrastructures, including the Internet infrastructure, to enhance secure and managed information sharing over a distributed networking environment. It defines an architecture framework for information management based on the use of digital entity, and a common set of secure services that will help the registration, discovery, resolution, and dissemination of such digital entities. The set of services is designed to facilitate sharing across any storage boundaries, any heterogeneous application boundaries, and any organization boundaries. Digital entity architecture defines a minimum set of needed architectural components, and services to provide a generic information and service interoperability. It will facilitate the interoperability of identification, description, representation, access, storage and security of IoT devices. This architecture framework encourages a common security and management interface across different IoT applications. Under a digital entity architecture, information represented in digital form is structured as digital entity, each of which has an associated unique persistent identifier. However, metadata contained in the digital entities (e.g. location of the object) could be updated without changing its identifier. The identifier allows the digital entities to be identified and discovered, regardless where they are located or stored. Digital entities are not confined within any particular application boundary and may be moved from host to host, accessed from application to application, shared from organization to organization, without losing its ownership or management control, in order to enhance interoperability. The digital entity's data model allows ownership and access control information to be defined by data owners independently of any specific applications. This Recommendation can be used with different identification and addressing protocols (e.g. IP and/or non IP based networks).
* ITU-T Y.4472 “Open data application programming interface (APIs) for IoT data in smart cities and communities”, intends to study the concept and potential of developing a secured open and interoperable API in the context of IoT deployment and open data management in smart cities. It will analyse current solutions implemented by Administrations around the world, where applicable, including those adopted by smart cities, to share their data through open and interoperable interfaces. This Recommendation presents a complete set of Open APIs dedicated to smart cities offering different features covering the needs of interoperable smart city framework development. In order to achieve interoperability among heterogeneous platforms and development of smart cities, the Recommendation proposed "interoperability points" in southbound and northbound in smart city framework. It provides a list of core API sets focusing on data interoperability, including context data management APIs, data transactions APIs, data storage APIs, and security APIs.
* ITU-T Y.4805 “Identifier service requirements for the interoperability of Smart City applications”, explores the set of requirements for identifier services used in Smart City. An identifier service for Smart City must be scalable and secure, and not only promote interoperability among different Smart City applications, but also compatible with any existing practices in the application domain. Purpose: This Recommendation proposes to specify a set of requirements for identifier services in Smart City, and the following aspects should be studied. Contents: - Application scenarios of interconnection and interworking in Smart City; - General requirements for identifier services in Smart City; - Reference models of identifier services in Smart City.
* ITU-T Y.4806 “Security capabilities supporting safety of the Internet of Things”, provides a classification of security issues for the Internet of Things based on the impact vector of a probable attack, examines the security threats that may affect the functional safety of cyber-physical systems, and describes how security capabilities defined in Recommendation ITU-T Y.2068 support safe execution of cyber-physical systems in the Internet of Things. The Appendix of this Recommendation considers how the joint analysis of threats and security capabilities mentioned herein may be used to establish requirements for protection mechanisms.
* ITU-T Y.4807 “Agility by design for Telecommunications/ICT Systems Security used in the Internet of Things”, addresses possible improvement of security and stability of the Internet of Things by ensuring the supporting Telecommunications/ICT systems and related infrastructure - protocols, standards, etc. - have the flexibility to keep up with advances in Telecommunications/ICT security and cryptography. This document intentionally does not provide guidance on specific cryptosystems, standards or algorithms.
* ITU-T Y.4808 “Digital entity architecture framework to combat counterfeiting in IoT”. There are challenges related to the use and circulation of counterfeit devices in the market, including adverse consequences for users, governments and the private sector. As documented in the ITU-T Technical Report on Counterfeit ICT equipment [b-ITU-T TR on Counterfeit ICT Equipment], there are a lot of technical solutions which are widely used for combating counterfeit products over the globe. The report indicates that RFID tags are among technologies which are used for combating counterfeiting. While this may be true, there are some difficulties associated with securing these systems with regard to the access control exercised to write on the tags. There are solutions established for combating counterfeit devices for specific technologies and/or industries which may not be applicable to all use cases. On the other hand, there are such solutions which may be applicable to all use cases, these solutions are based on the ITU-T Recommendations such as ITU -T Y.4459 "Digital entity architecture framework for Internet of things interoperability" and ITU-T X.1255 "Framework for discovery of identity management information". Resolution 188 (Busan, 2014) on combating counterfeit telecommunication/information and communication technology devices recognized (in recognizing e) that Recommendation ITU-T X.1255, which is based on the digital entity architecture, provides a framework for discovery of identity management information. A digital entity architecture, as described in ITU-T Y.4459, defines a minimum set of needed architectural components and services to provide a generic information and service interoperability. It will facilitate the interoperability of identification, description, representation, access, storage and security of IoT devices. This architecture framework encourages a common security and management interface across different IoT applications. Digital entity architecture provides additional means of security (e.g. public key infrastructure) features to authenticate the parties involved in the identifiers registration process. Other industry approaches to combat counterfeiting are available. They rely on commonly acknowledged identifiers including, but not limited to MAC, IMEI, RFID, …etc. Systems based on digital entity architecture may be considered as one category of candidate tools which allow vendors/industries (not only ICT industry) to store their products' profile in digital form. Therefore, this Recommendation can be used in different industries such as ICT, pharmaceutical, automotive, avionic.
* ITU-T Y.4809 “Unified IoT Identifiers for intelligent transport systems”, defines field formats for identifying road signs and signals, and identifies specific values for identifiers of such signs and signals.
* ITU-T Y.4810 “Requirements of data security for the heterogeneous IoT devices”, aims to describe requirements of data security for the heterogeneous IoT devices under specific scenarios.
* ITU-T Y.4811 “Reference framework of converged service for identification and authentication for IoT devices in decentralized environment”, targets to develop a converged identification and authentication service to overcome relevant challenges in decentralized IoT identification and authentication management systems, so as to ensure efficient communication among IoT devices and services in decentralized environment.
* ITU-T Y.Suppl.61 to ITU-T Y.4400 series “Features of application programming interface (APIs) for IoT data in smart cities and communities”. A growing number of smart cities and Administrations are inclined to collaborate and mutualise their efforts and resources for IoT deployments and open data sharing. This Supplement intends to study the concept and potential of developing a secured open and interoperable APIs in the context of IoT deployment and open data management in smart cities. It will analyse current solutions implemented by Administrations around the world, where applicable, including those adopted by smart cities, to share their data through open and interoperable interfaces. It will subsequently specify an open and interoperable APIs for secured Open Data architecture as well as to support IoT data interoperability for smart cities. The work will be concluded by mapping the specified APIs with relevant work performed by other international SDOs and alliances, which help consolidate the standards developed on the topic.

**g) Q7/20, Evaluation and assessment of Smart Sustainable Cities and Communities**

Question 7/20 looks into assessment and measurement of smart sustainable cities and communities. Tasks of Q7/20 include:

Developing Recommendations, Reports, Guidelines, etc. as appropriate on:

* Methodologies for assessment of city SDGs, considering general principles, criteria for evaluating ICT impact.
* Collecting and calculating reliable data to feed into the assessment model.
* Developing methodologies for measuring and evaluating a city's specific performance and e/smart services with respect to defined sector indicators.
* Reporting on the Global Smart Sustainable Cities Index.
* Reporting a city's performance to help cities to reach SDGs.

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

In this study period, Q7/20 has developed 5 new Recommendations and revised 3 Supplements:

* ITU-T Y.4904 “Smart sustainable cities maturity model”, contains a maturity model for smart sustainable cities. This maturity model helps identify the goals, levels and key measures that are recommended for cities to effectively examine their current situation and determine critical capabilities needed to progress toward the long-term goal of becoming SSCs. The Recommendation includes: - Smart Sustainable City Maturity Model (SSC-MM), - maturity dimensions in smart sustainable cities, - maturity levels for smart sustainable cities, and - mapping of key performance indicators in smart sustainable cities.
* ITU-T Y.4905 “Smart sustainable city impact assessment”, is a holistic impact framework for assessment for smart and sustainable cities to address effects of digital innovation on social, economic, and environmental issues. Smart sustainable city (SSC) initiatives have been proposed as potential solutions to economic, social and environmental challenges and pressures encountered by cities. Advances in Information and Communication Technologies (ICTs) enable significant transformation potential in the way city resources, services and infrastructures are planned and managed. More specifically, ICT can play an enabling role to address the urban challenges of 21st century. SSCs harness ICTs (including various subtopics under ICT such as digital transformation, data, IoT, digital services, etc.) and intend to deliver city enhancements through a portfolio of action items. By their very nature, SSC initiatives impact the underlying cities. It is important to identify and asses this impact. Identification and assessment of impact will allow better planning, setting expectations with stakeholders, better informed budgeting, more effective public private partnerships, and promotion of alternative financing mechanisms. This will also help in communicating SSC initiatives.
* ITU-T Y.4906 “Assessment framework for digital transformation of sectors in smart cities”, is to enhance the sustainability of identified priority sectors in smart cities, in order to optimise economic, environmental and social benefits. Cities will decide on their digital transformation priorities. For example, cities might also want to encourage collaboration to deliver desired outcomes. This kind of engagement based on the assessment framework can incentivize industry engagement and investment. Content of this Recommendation are as follows: 1 Introduction of the assessment framework and its components 2 Identification of indicators - Examples of categories of indicators to assist in this objective for the assessment frameworks include: - Digital infrastructure - Digital transformation initiatives for sectors - Collaboration efforts on digital transformation - Economic, environmental and social benefits according to sector digital transformation 3 Sector assessment and analysis.
* ITU-T Y.4907 “Reference architecture of blockchain-based unified KPI data management for smart sustainable cities”, provides a reference architecture for blockchain-based unified KPI (key performance indicator) data management for smart sustainable cities (BKDMS). This Recommendation provides the concept, characteristics and high-level requirements of BKDMS. A reference architecture including capabilities of its functional entities is described in details, and unified structures of KPI data are also introduced with which to ensure BKDMS realizable.
* ITU-T Y.4908 “Performance evaluation frameworks of e-health systems in the IoT​”, addresses the need for effective performance evaluation frameworks of e-health systems in the IoT.
* ITU-T Y.Suppl.32 to ITU-T Y.4000 series “Smart sustainable cities - A guide for city leaders”, is intended for city decision makers and strategists, whose decisions have a significant impact on the way their city functions and its future development trajectory. Accordingly, this high level policy document helps identify practical steps based on which urban decision makers can envisage and build a smart sustainable city (SSC).
* ITU-T Y.Suppl.33 to ITU-T Y.4000 series “Smart sustainable cities - Master plan”, seeks to provide municipalities and interested stakeholders with a general overview of the stages and technical specifications that need to be considered to effectively apply the notion of the smart sustainable city (SSC) to their respective locations. It provides a guide for the implementation of SSC based on intensive use of information and communication technologies (ICTs), and refers the reader to a series of thematic reports that addresses the specific technical aspects involved in the design and operation of SSC strategies. While building upon expertise available in the field, this Supplement is intended to be as general and inclusive as possible. It aims to inform the design of SSC strategies of any municipality, irrespective of its size, location or resource availability, in both developed and developing countries.
* ITU-T Y.Suppl.34 to ITU-T Y.4000 series “Smart sustainable cities - Setting the stage for stakeholders' engagement”, seeks to provide municipalities and interested stakeholders with a general overview of the stages and technical specifications that need to be considered to effectively apply the notion of the smart sustainable city (SSC) to their respective locations. It provides a guide for the implementation of SSC based on intensive use of information and communication technologies (ICTs), and refers the reader to a series of thematic reports that addresses the specific technical aspects involved in the design and operation of SSC strategies. While building upon expertise available in the field, this Supplement is intended to be as general and inclusive as possible. It aims to inform the design of SSC strategies of any municipality, irrespective of its size, location or resource availability, in both developed and developing countries.

**3.3 Report of lead study group activities, JCA, regional groups, focus groups and projects**

Study Group 20 is the lead study group on Internet of things (IoT) and smart cities and communities (SC&C). The lead study group activities are shared as follows:

* Lead study group on Internet of things (IoT) and its applications;
* Lead study group on smart cities and communities, including its e‑services and smart services; and
* Lead study group for Internet of things identification.

Lead Study Group activities of SG20 have been reported to each TSAG meeting.

**3.3.1 Lead study group activities on Internet of things (IoT) and its applications**

Study Group 20 has been designated as the Lead Study Group (LSG) on Internet of things (IoT) and its applications in accordance with World Telecommunication Standardization Assembly (WTSA-16) Resolution 2.

As the lead study group for studies relating to Internet of things (IoT) and its applications, Study Group 20 is responsible for the study of the appropriate core Questions on Internet of things (IoT), end-to-end architectures for IoT, and mechanisms for the interoperability of IoT applications and datasets employed by various vertically oriented industry sectors.

SG20 organized the following workshops and forums:

* [First Forum on "Data Management: Transforming Data Into Value"](https://www.itu.int/en/ITU-T/Workshops-and-Seminars/iot/201703/Pages/default.aspx)

12 March 2017, Dubai, UAE

* [IoT Week 2017](http://iot-week.eu/)

6-9 June 2017, Geneva, Switzerland

* [1st ITU Workshop on Data Processing and Management for IoT and Smart Cities & Communities](https://www.itu.int/en/ITU-T/Workshops-and-Seminars/20180219/Pages/default.aspx)  
  19 February 2018, Brussels, Belgium
* [Forum on Exploring the Potential of Artificial Intelligence and Internet of Things](https://www.itu.int/en/ITU-T/Workshops-and-Seminars/20180506/Pages/default.aspx)  
  6 May 2018, Cairo, Egypt
* [Forum on Artificial Intelligence and Internet of Things in the development of Smart Sustainable Cities](https://www.itu.int/en/ITU-T/Workshops-and-Seminars/gsw/201804/Pages/Programme11.aspx)  
  11 April 2018, Zanzibar, Tanzania
* [ITU Regional Forum on “Internet of Things, Telecommunication Networks and Big Data as Basic Infrastructure for Digital Economy”](https://www.itu.int/en/ITU-T/Workshops-and-Seminars/20180604/Pages/default.aspx)  
  4-6 June 2018 (AM only), St. Petersburg, Russian Federation
* [IoT Week 2018](https://iotweek.org/iot-week-bilbao/)  
  4-7 June 2018, Bilbao, Spain
* [Second ITU Workshop on Data Processing and Management for IoT and Smart Cities & Communities](https://www.itu.int/en/ITU-T/Workshops-and-Seminars/20180917/Pages/default.aspx)  
  17 September 2018, Tunis, Tunisia
* [Third ITU Workshop on Data Processing and Management for IoT and Smart Cities & Communities](https://www.itu.int/en/ITU-T/Workshops-and-Seminars/201901/Pages/default.aspx)  
  Bundang, Seoul Korea (Rep. of), 14 January 2019
* [IoT Week](https://iotweek.org/iot-week-2019-aarhus/)  
  11-21 June 2019, Aarhus, Denmark
* [Fourth ITU Workshop on Data Processing and Management for IoT and Smart Cities & Communities](https://www.itu.int/en/ITU-T/Workshops-and-Seminars/20190719/Pages/default.aspx)Geneva, 19 July 2019
* [5th ITU Workshop on Data Processing and Management for IoT and Smart Cities & Communities](https://www.itu.int/en/ITU-T/climatechange/dpm/05/Pages/default.aspx)  
  25 November 2019, Geneva

**Recommendations approved:**

| **Recommen­dation** | **Title** |
| --- | --- |
| [Y.4003](http://www.itu.int/itu-t/workprog/wp_item.aspx?isn=13682) | Overview of smart manufacturing in the context of the industrial Internet of things |
| [Y.4114](http://www.itu.int/itu-t/workprog/wp_item.aspx?isn=13658) | Specific requirements and capabilities of the IoT for Big Data |
| [Y.4116](http://www.itu.int/itu-t/workprog/wp_item.aspx?isn=13686) | Requirements of transportation safety service including use cases and service scenarios |
| [Y.4117](http://www.itu.int/itu-t/workprog/wp_item.aspx?isn=13660) | Requirements and capabilities of Internet of Things for support of wearable devices and related services |
| [Y.4118](http://www.itu.int/itu-t/workprog/wp_item.aspx?isn=13664) | Internet of Things requirements and technical capabilities for support of accounting and charging |
| [Y.4119](http://www.itu.int/itu-t/workprog/wp_item.aspx?isn=14105) | Requirements and capability framework for IoT-based automotive emergency response system |
| [Y.4120](http://www.itu.int/itu-t/workprog/wp_item.aspx?isn=13698) | Requirements of Internet of things applications for smart retail stores |
| [Y.4121](http://www.itu.int/itu-t/workprog/wp_item.aspx?isn=13667) | Requirements of an Internet of Things enabled network for support of applications for global processes of the Earth |
| [Y.4122](https://www.itu.int/itu-t/workprog/wp_item.aspx?isn=14644) | Requirements and capability framework of edge computing-enabled gateway in the IoT |
| [Y.4123](http://www.itu.int/itu-t/workprog/wp_item.aspx?isn=16655) | Requirements and capability framework of smart shopping mall system |
| [Y.4202](http://www.itu.int/itu-t/workprog/wp_item.aspx?isn=13657) | Framework of wireless power transmission application service |
| [Y.4203](http://www.itu.int/itu-t/workprog/wp_item.aspx?isn=13687) | Requirements of things description in the Internet of things |
| [Y.4204](http://www.itu.int/itu-t/workprog/wp_item.aspx?isn=13697) | Accessibility requirements for the Internet of things applications and services |
| [Y.4206](http://www.itu.int/itu-t/workprog/wp_item.aspx?isn=14304) | Requirements and capabilities of user-centric work space service |
| [Y.4208](http://www.itu.int/itu-t/workprog/wp_item.aspx?isn=14499) | IoT requirements for support of edge computing |
| [Y.4210](http://www.itu.int/itu-t/workprog/wp_item.aspx?isn=14500) | Requirements and use cases for universal communication module of mobile IoT devices |
| [Y.4212](http://www.itu.int/itu-t/workprog/wp_item.aspx?isn=14106) | Requirements and capabilities of network connectivity management in the Internet of things |
| [Y.4213](http://www.itu.int/itu-t/workprog/wp_item.aspx?isn=14960) | IoT requirements and capability framework for monitoring physical city assets |
| [Y.4214](https://www.itu.int/ITU-T/workprog/wp_search.aspx?isn_task=16654) | Requirements of IoT-based civil engineering infrastructure health monitoring system |
| [Y.4215](https://www.itu.int/ITU-T/workprog/wp_search.aspx?isn_task=14303) | Use cases, requirements and capabilities of unmanned aircraft systems for the Internet of Things |
| [Y.4101/Y.2067](http://www.itu.int/itu-t/workprog/wp_item.aspx?isn=13689) | Common requirements and capabilities of a gateway for Internet of Things applications |
| [Y.4115](http://www.itu.int/itu-t/workprog/wp_item.aspx?isn=13681) | Reference architecture for IoT device capabilities exposure |
| [Y.4415](https://www.itu.int/itu-t/workprog/wp_item.aspx?isn=13663) | Architecture of web of objects based virtual home network |
| [Y.4416](http://www.itu.int/itu-t/workprog/wp_item.aspx?isn=13661) | Architecture of the Internet of things based on next generation network evolution |
| [Y.4417](http://www.itu.int/itu-t/workprog/wp_item.aspx?isn=13659) | Framework of self-organization network in the IoT environments |
| [Y.4418](http://www.itu.int/itu-t/workprog/wp_item.aspx?isn=13654) | Functional architecture of gateway for Internet of things applications |
| [Y.4419](https://www.itu.int/itu-t/workprog/wp_item.aspx?isn=16395) | Requirements and Capability Framework of Smart Utility Metering (SUM) |
| [Y.4420](https://www.itu.int/itu-t/workprog/wp_item.aspx?isn=14966) | Framework of IoT based monitoring and management for Lift |
| Y.4421 | Functional architecture for unmanned aerial vehicles and unmanned aerial vehicle controllers using IMT-2020 networks |
| [Y.4455](http://www.itu.int/itu-t/workprog/wp_item.aspx?isn=13680) | Reference architecture for IoT network service capability exposure |
| [Y.4460](http://www.itu.int/itu-t/workprog/wp_item.aspx?isn=14655) | Architectural reference models of devices for IoT applications |
| [Y.4462](http://www.itu.int/itu-t/workprog/wp_item.aspx?isn=13710) | Requirements and functional architecture of open IoT identity correlation service |
| [Y.4467](http://www.itu.int/itu-t/workprog/wp_item.aspx?isn=14502) | Minimum set of data structure for automotive emergency response system |
| [Y.4468](http://www.itu.int/itu-t/workprog/wp_item.aspx?isn=14501) | Minimum set of data transfer protocol for automotive emergency response system |
| [Y.4469](http://www.itu.int/itu-t/workprog/wp_item.aspx?isn=14654) | Reference architecture of spare computational capability exposure of IoT devices for smart home |
| [Y.4473](http://www.itu.int/itu-t/workprog/wp_item.aspx?isn=16403) | SensorThings API - Sensing |
| [Y.4474](http://www.itu.int/itu-t/workprog/wp_item.aspx?isn=16397) | Functional architecture for IoT services based on Visible Light Communications |
| [Y.4475](http://www.itu.int/itu-t/workprog/wp_item.aspx?isn=14332) | Lightweight intelligent software framework for IoT devices |
| [Y.4477](http://www.itu.int/itu-t/workprog/wp_item.aspx?isn=13709) | Framework of service interworking with device discovery and management in heterogeneous Internet of things environments |
| [Y.4500.1](http://www.itu.int/itu-t/workprog/wp_item.aspx?isn=14320) | oneM2M- Functional Architecture |
| [Y.4500.2](http://www.itu.int/itu-t/workprog/wp_item.aspx?isn=14330) | oneM2M- Requirements |
| [Y.4500.4](http://www.itu.int/itu-t/workprog/wp_item.aspx?isn=14317) | oneM2M- Service Layer Core Protocol Specification |
| [Y.4500.5](http://www.itu.int/itu-t/workprog/wp_item.aspx?isn=14321) | oneM2M- Management enablement (OMA) |
| [Y.4500.6](http://www.itu.int/itu-t/workprog/wp_item.aspx?isn=14327) | oneM2M Management enablement (BBF) |
| [Y.4500.8](http://www.itu.int/itu-t/workprog/wp_item.aspx?isn=14316) | oneM2M- CoAP Protocol Binding |
| [Y.4500.9](http://www.itu.int/itu-t/workprog/wp_item.aspx?isn=14315) | oneM2M- HTTP Protocol Binding |
| [Y.4500.10](http://www.itu.int/itu-t/workprog/wp_item.aspx?isn=14314) | oneM2M- MQTT Protocol Binding |
| [Y.4500.11](http://www.itu.int/itu-t/workprog/wp_item.aspx?isn=14313) | oneM2M- Common Terminology |
| [Y.4500.12](http://www.itu.int/itu-t/workprog/wp_item.aspx?isn=14326) | oneM2M Base Ontology |
| [Y.4500.13](http://www.itu.int/itu-t/workprog/wp_item.aspx?isn=14312) | oneM2M- Interoperability Testing |
| [Y.4500.14](http://www.itu.int/itu-t/workprog/wp_item.aspx?isn=14306) | oneM2M- LwM2M Interworking |
| [Y.4500.15](http://www.itu.int/itu-t/workprog/wp_item.aspx?isn=14322) | oneM2M- Testing framework |
| [Y.4500.20](http://www.itu.int/itu-t/workprog/wp_item.aspx?isn=14307) | oneM2M- WebSocket Protocol Binding |
| [Y.4500.22](http://www.itu.int/itu-t/workprog/wp_item.aspx?isn=14323) | oneM2M- Field Device Configuration |
| [Y.4500.23](http://www.itu.int/itu-t/workprog/wp_item.aspx?isn=14324) | oneM2M-Home Appliances Information Model and Mapping |
| [Y.4500.32](http://www.itu.int/itu-t/workprog/wp_item.aspx?isn=14308) | oneM2M- MAF and MEF Interface Specification |
| [Y.4457](http://www.itu.int/itu-t/workprog/wp_item.aspx?isn=13677) | Architectural framework for transportation safety services |
| [Y.4463](http://www.itu.int/itu-t/workprog/wp_item.aspx?isn=13676) | Framework of delegation service for IoT devices |
| [Y.4464](http://www.itu.int/itu-t/workprog/wp_item.aspx?isn=14099) | Framework of blockchain of things as decentralized service platform |
| [Y.4465](http://www.itu.int/itu-t/workprog/wp_item.aspx?isn=14963) | Framework of IoT Services based on Visible Light Communications |
| [Y.4476](http://www.itu.int/itu-t/workprog/wp_item.aspx?isn=14962) | OID-based resolution framework for transactions of a distributed ledger assigned to IoT resources |
| [Y.4480](https://www.itu.int/itu-t/workprog/wp_item.aspx?isn=17210) | Low power protocol for wide area wireless networks |
| [Y.4555](http://www.itu.int/itu-t/workprog/wp_item.aspx?isn=13701) | Service functionalities of self-quantification over Internet of things |
| [Y.4558](http://www.itu.int/itu-t/workprog/wp_item.aspx?isn=15090) | Requirements and functional architecture of smart fire smoke detection service |
| [Y.4559](https://www.itu.int/ITU-T/recommendations/rec.aspx?rec=14424) | Requirements and functional architecture of base station inspection services using unmanned aerial vehicles |
| [Y.4560](http://www.itu.int/itu-t/workprog/wp_item.aspx?isn=16401) | Blockchain-based data exchange and sharing for supporting Internet of things and smart cities and communities |
| [Y.4561](http://www.itu.int/itu-t/workprog/wp_item.aspx?isn=16402) | Blockchain-based Data Management for supporting Internet of things and smart cities and communities |
| [Y.4563](http://www.itu.int/itu-t/workprog/wp_item.aspx?isn=16393) | Requirements and functional model to support data interoperability in IoT environments |
| [Y.4205](http://www.itu.int/itu-t/workprog/wp_item.aspx?isn=13696) | Requirements and reference model of IoT-related crowdsourced systems |

**Supplements agreed**

| **Supplement** | **Title** |
| --- | --- |
| [Y.Sup.53 to Y.4000 series](http://www.itu.int/itu-t/workprog/wp_item.aspx?isn=13699) | IoT use cases |
| [Y.Sup.52 to ITU-T Y.4000-series](http://www.itu.int/itu-t/workprog/wp_item.aspx?isn=14296) | Methodology for building digital capabilities during enterprises' digital transformation |
| [Y.Sup.54 to ITU-T Y.4000-series](http://www.itu.int/itu-t/workprog/wp_item.aspx?isn=13691) | Framework for home environment profiles and levels of IoT systems |
| [Y.Suppl.61 to ITU-T Y.4400 series](http://www.itu.int/itu-t/workprog/wp_item.aspx?isn=16410) | Features of application programming interface (APIs) for IoT data in smart cities and communities |
| [Y.Suppl.62 to ITU-T Y.4000 series](http://www.itu.int/itu-t/workprog/wp_item.aspx?isn=16404) | Overview of blockchain for supporting Internet of things and smart cities and communities in data processing and management aspects |
| [Y.Suppl.63 to ITU-T Y.4000 series](http://www.itu.int/itu-t/workprog/wp_item.aspx?isn=14103) | Unlocking Internet of things with artificial intelligence |
| [Y.Suppl.68](https://www.itu.int/itu-t/workprog/wp_item.aspx?isn=14647) | Framework for Internet of Things ecosystem Master Plan |

**Informative texts agreed**

| **Supplement** | **Title** |
| --- | --- |
| [Y.oneM2M.DG.AppDev](http://www.itu.int/itu-t/workprog/wp_item.aspx?isn=14309) | oneM2M- Application developer guide: Light control example using HTTP binding |
| [Y.oneM2M.DG.CoAP](http://www.itu.int/itu-t/workprog/wp_item.aspx?isn=14310) | oneM2M Developer Guide of CoAP binding and long polling for temperature monitoring |
| [Y.oneM2M.DG.DM](http://www.itu.int/itu-t/workprog/wp_item.aspx?isn=14311) | oneM2M- Developer guide of device management |
| [Y.oneM2M.Ind.DE](http://www.itu.int/itu-t/workprog/wp_item.aspx?isn=14325) | oneM2M Industrial Domain Enablement |
| [Y.oneM2M.UCC](http://www.itu.int/itu-t/workprog/wp_item.aspx?isn=14329) | oneM2M Use Case Collection |
| [Y.oneM2M.DG.SEM](http://www.itu.int/itu-t/workprog/wp_item.aspx?isn=14319) | oneM2M-Developer Guide of Implementing semantics |

**3.3.2 Lead study group activities on smart cities and communities, including its e‑services and smart services**

Study Group 20 has been designated the Lead Study Group (LSG) on smart cities and communities, including its e‑services and smart services in accordance with World Telecommunication Standardization Assembly (WTSA-16) Resolution 2.

As the lead study group for studies relating to smart cities and communities, including its e‑services and smart services, Study Group 20 is responsible for the study of the appropriate core Questions on evaluation and assessment of Smart Sustainable Cities and Communities, and e/Smart services, applications and supporting platforms.

SG20 organized the following workshops and forums on smart cities:

* [Special session on Smart Sustainable Manizales](https://www.itu.int/en/ITU-T/Workshops-and-Seminars/gsw/201704/Pages/programme-20170404pm.aspx)

4 April 2017 (14:00 - 15:00), Manizales, Colombia

* [XVIII Ibero-American Meeting of Digital Cities](https://www.itu.int/en/ITU-T/Workshops-and-Seminars/gsw/201704/Pages/programme-20170403.aspx)

3 April 2017, Manizales, Colombia

* [Workshop on Smart Sustainable Cities](https://www.itu.int/en/ITU-T/Workshops-and-Seminars/20170601/Pages/default.aspx)

1-2 June 2017, Samarkand, Uzbekistan

* [World Smart City Forum](https://www.worldsmartcity.org/)

15 November 2017, Barcelona, Spain

* [1st Forum on Artificial Intelligence and the Internet of Things in Smart Sustainable Cities in Latin America](https://www.itu.int/en/ITU-T/Workshops-and-Seminars/20180530/Pages/default.aspx)

29-30 May 2018, Buenos Aires, Argentina

* [Information Session on "Exploring the Role of Small Medium Enterprises (SMEs) in Linking AI and IoT in Smart Cities"](https://www.itu.int/en/ITU-T/Workshops-and-Seminars/20180531/Pages/Programme.aspx)

30 May 2018 (9:30 to 11:30 a.m.), Buenos Aires, Argentina

* [The 4th Asia-Pacific Regional Forum on Smart Sustainable Cities and e-Government 2018](https://www.itu.int/en/ITU-D/Regional-Presence/AsiaPacific/Pages/Events/2018/ssceg2018/home.aspx)

4-6 July 2018, Thanh Hoa city, Viet Nam

* [Shaping smarter and more sustainable cities: Striving for Sustainable Development Goals](https://www.itu.int/en/ITU-T/Workshops-and-Seminars/20180712/Pages/default.aspx)

12 July 2018, New York, United States

* [World Smart City Forum](https://www.worldsmartcity.org/)

29 November 2018, Santa Fe, Argentina

* [ITU Forum on Artificial Intelligence, Internet of Things and Smart Cities](https://www.itu.int/en/ITU-T/Workshops-and-Seminars/201812/Pages/default.aspx)

3 December 2018, Wuxi, China

* [ITU-UN-Habitat-UNDP Forum on Smart sustainable cities: technological trends, success stories and future prospects](https://www.itu.int/en/ITU-D/Regional-Presence/CIS/Pages/EVENTS/2019/02_Minsk/02_Minsk.aspx)

26-27 February 2019, Minsk, Belarus

* [ITU Training on Key performance indicators for smart sustainable cities to achieve the SDGs](https://www.itu.int/en/ITU-D/Regional-Presence/CIS/Pages/EVENTS/2019/02_Minsk/02_Minsk.aspx)

27 February 2019 (11h30- 16h00), Minsk, Belarus

* [Thematic Workshop on United for Smart Sustainable Cities: Blockchain for Cities](https://www.itu.int/net4/wsis/forum/2019/Agenda/ViewSession/296)

11 April 2019 (09h00 - 10h45), Room K1, ITU headquarters, Geneva, Switzerland

* [Thematic Workshop on En-gendering the smart city](https://www.itu.int/net4/wsis/forum/2019/Agenda/ViewSession/277)

11 April 2019 (13h15 - 14h00), Room C2, ITU headquarters, Geneva, Switzerland

* [1st Digital African Week: Training on "Smart Sustainable Cities, Products and Services"](https://www.itu.int/en/ITU-T/studygroups/2017-2020/20/sg20rgafr/20190827/Pages/default.aspx)

27 August 2019, Abuja, Nigeria

* [1st Digital African Week: ITU Forum on "Smart Sustainable Africa"](https://www.itu.int/en/ITU-T/studygroups/2017-2020/20/sg20rgafr/201903/Pages/default.aspx)

28 August 2019, Abuja, Nigeria

* [Session on "Smart Sustainable Cities & Communities"](https://www.itu.int/en/ITU-T/climatechange/Pages/201909.aspx)

5 September 2019, Addis Ababa, Ethiopia

* [9th Green Standards Week: Leadership Panel on "Connecting Smart Sustainable Cities with the Sustainable Development Goals"](https://www.itu.int/en/ITU-T/Workshops-and-Seminars/gsw/201910/Pages/programme-02.aspx)

1 October 2019, Valencia, Spain

* [9th Green Standards Week: Forum on "Smart Governance in Cities"](https://www.itu.int/en/ITU-T/Workshops-and-Seminars/gsw/201910/Pages/programme-06.aspx)

2 October 2019, Valencia, Spain

* [9th Green Standards Week: València: Smart City](https://www.itu.int/en/ITU-T/Workshops-and-Seminars/gsw/201910/Pages/programme-07.aspx)

2 October 2019, Valencia, Spain

* [9th Green Standards Week: Meeting of the Spanish Expert Committee on Smart Sustainable Cities (RECI)](https://www.itu.int/en/ITU-T/Workshops-and-Seminars/gsw/201910/Pages/programme-09.aspx)

3 October 2019, Valencia, Spain

* [9th Green Standards Week: Training on Building Smarter and More Sustainable Cities](https://www.itu.int/en/ITU-T/Workshops-and-Seminars/gsw/201910/Pages/programme-08.aspx)

4 October 2019, Valencia, Spain

* [World Cities Day - Session on "Smart and sustainable cities: Changing the world: innovations and better life for future generations"](https://www.itu.int/en/ITU-T/climatechange/Documents/World_Cities_Day_Session_on_SSC.pdf)

31 October 2019 (15h00-16h30), New York, UNHQ

* [WUF10 Networking event on "Governing and managing smart sustainable cities"](https://www.itu.int/en/ITU-T/climatechange/Pages/202002.aspx)

10 February 2020, Abu Dhabi, UAE

* [ITU Forum "Smart sustainable cities: from concept to implementation"](https://www.itu.int/en/ITU-D/Regional-Presence/CIS/Pages/EVENTS/2020/03_Minsk/03_Minsk.aspx)

3-5 March 2020, Minsk, Belarus

* [Webinar on "Accelerating cities' transformation through standards"](https://www.itu.int/en/ITU-T/climatechange/Pages/202006.aspx)

Virtual, 25 June 2020

* [Virtual session on "Using international standards to build smart sustainable cities and tackle climate change"](https://www.itu.int/en/ITU-T/climatechange/Pages/20201015.aspx)  
  Virtual, 15 October 2020
* [Virtual forum on "Digital Transformation of Cities and Communities"](https://www.itu.int/en/ITU-T/climatechange/Pages/20201207.aspx)  
  Virtual session, 7 December 2020
* [Webinar on "Smart sustainable cities and frontier technologies in Latin America"](https://www.itu.int/en/ITU-T/climatechange/Pages/202012.aspx)   
  Virtual, 8 December 2020
* [WSIS Thematic Workshop on "Simple Ways to be Smart"](https://www.itu.int/net4/wsis/forum/2021/Agenda/Session/249)

Virtual, 29 March 2021

* [Virtual Forum on "The Role of Standards in Accelerating Digital Transformation for Cities and Communities"](https://www.itu.int/en/ITU-T/climatechange/Pages/20210422.aspx)

Virtual, 23 April 2021

* [ITU-T SG20RG-AFR Virtual forum on “Accelerating Digital Transformation in Africa”](https://www.itu.int/en/ITU-T/climatechange/Pages/20210602.aspx)

Virtual, 2 June 2021

* [ITU/OiER Webinar on Accelerating the Path to Cities’ Digital Transformation](https://www.itu.int/en/ITU-T/webinars/20210908/Pages/default.aspx)  
  Virtual, 8 September 2021
* [Webinar series on Digital transformation for cities and communities](https://www.itu.int/en/ITU-T/webinars/Pages/dt4cc.aspx)  
  Virtual, September - December 2021
* [DT4CC Episode #1: Digital twins in cities](https://www.itu.int/en/ITU-T/webinars/202109/Pages/default.aspx)  
  Virtual, 8 September 2021
* [DT4CC Episode #2: IoT-based automotive emergency response system](https://www.itu.int/en/ITU-T/webinars/20210914/Pages/default.aspx)  
  Virtual, 14 September 2021
* [DT4CC Episode #3: Smart sustainable city architectures: challenges and opportunities](https://www.itu.int/en/ITU-T/webinars/20210916/Pages/default.aspx)  
  Virtual, 16 September 2021
* [DT4CC Episode #4: Smart Cities: a step towards digital transformation in Latin America](https://www.itu.int/en/ITU-T/webinars/20210920/Pages/default.aspx) (Spanish only)  
  Virtual, 20 September 2021
* [DT4CC Episode #5: Smart sustainable cities maturity model and impact assessment](https://www.itu.int/en/ITU-T/webinars/20210924/Pages/default.aspx)  
  Virtual, 24 September 2021
* [Webinar to celebrate World Cities Day on Building climate resilient cities with digital transformation](https://www.itu.int/net4/wsis/forum/2022/Agenda/Session/109)  
  Virtual, 28 October 2021
* [DT4CC Episode #6: Smart City Platforms](https://www.itu.int/en/ITU-T/webinars/20211101/Pages/default.aspx)  
  Virtual, 1 November 2021
* [DT4CC Episode #7: Crowdsourced Systems: A people-led paradigm](https://www.itu.int/en/ITU-T/webinars/20211102/Pages/default.aspx)  
  Virtual, 2 November 2021
* [DT4CC Episode #8: Network capabilities and emerging technologies to support IoT-enabled verticals](https://www.itu.int/en/ITU-T/webinars/20211118/Pages/default.aspx)  
  Virtual, 18 November 2021
* [DT4CC Episode #10: The role of digital technologies on aging and health](https://www.itu.int/en/ITU-T/webinars/20211207/Pages/default.aspx)

Virtual, 7 December 2021

* [DT4CC Episode #11: Blockchain-based data management for supporting Internet of things and smart cities and communities](https://www.itu.int/en/ITU-T/webinars/20211208/Pages/default.aspx)

Virtual, 8 December 2021

* [DT4CC Episode #12: IoT for Earth Observation and Sustainable Development – opportunities and challenges](https://www.itu.int/en/ITU-T/webinars/20211214/Pages/default.aspx)

Virtual, 14 December 2021

* [DTC4CC Episode #13: Architecting the Web of Things](https://www.itu.int/en/ITU-T/webinars/20220203/Pages/default.aspx)  
  Virtual, 3 February 2022

**Approved Recommendations**

|  |  |
| --- | --- |
| **Recommendation** | **Subject / Title** |
| [Y.4004](http://www.itu.int/itu-t/workprog/wp_item.aspx?isn=16409) | Overview of smart oceans and seas, and requirements for their ICT implementations |
| [Y.4200](http://www.itu.int/itu-t/workprog/wp_item.aspx?isn=14098) | Requirements for interoperability of smart city platforms |
| [Y.4201](http://www.itu.int/itu-t/workprog/wp_item.aspx?isn=13672) | High-level requirements and reference framework of smart city platform |
| [Y.4461](http://www.itu.int/itu-t/workprog/wp_item.aspx?isn=13670) | Framework of open data in smart cities |
| [Y.4207](http://www.itu.int/itu-t/workprog/wp_item.aspx?isn=13706) | Requirements and capability framework of smart environmental monitoring |
| [Y.4209](http://www.itu.int/itu-t/workprog/wp_item.aspx?isn=13683) | Requirements for interoperation of the smart port with the smart city |
| [Y.4211](https://www.itu.int/ITU-T/recommendations/rec.aspx?rec=14577) | Accessibility requirements for smart public transportation services |
| [Y.4415](http://www.itu.int/itu-t/workprog/wp_item.aspx?isn=13663) | Architecture of web of objects based virtual home network |
| [Y.4456](http://www.itu.int/itu-t/workprog/wp_item.aspx?isn=13705) | Requirements and Functional Architecture for Smart Parking Lot in Smart City |
| [Y.4458](http://www.itu.int/itu-t/workprog/wp_item.aspx?isn=14101) | Requirements and functional architecture of smart street light service |
| [Y.4466](http://www.itu.int/itu-t/workprog/wp_item.aspx?isn=13678) | Framework of smart greenhouse service |
| [Y.4470](http://www.itu.int/itu-t/workprog/wp_item.aspx?isn=14503) | Reference architecture of artificial intelligence service exposure for smart sustainable cities |
| [Y.4471](https://www.itu.int/itu-t/workprog/wp_item.aspx?isn=14652) | Functional architecture of network-based driving assistance for autonomous vehicles |
| [Y.4472](https://www.itu.int/ITU-T/workprog/wp_item.aspx?isn=14297) | Open data application programming interface (APIs) for IoT data in smart cities and communities |
| [Y.4478](https://www.itu.int/itu-t/workprog/wp_item.aspx?isn=15094) | Requirements and functional architecture for smart construction site services |
| [Y.4556](http://www.itu.int/itu-t/workprog/wp_item.aspx?isn=13669) | Requirements and functional architecture of smart residential community |
| [Y.4562](http://www.itu.int/itu-t/workprog/wp_item.aspx?isn=14100) | Functions and metadata of spatiotemporal information service for smart cities |
| [Y.4051](http://www.itu.int/itu-t/workprog/wp_item.aspx?isn=13692) | Vocabulary for smart cities and communities |
| [Y.4904](http://www.itu.int/itu-t/workprog/wp_item.aspx?isn=14301) | Smart sustainable cities maturity model |
| [Y.4905](http://www.itu.int/itu-t/workprog/wp_item.aspx?isn=14300) | Smart sustainable city impact assessment |
| [Y.4906](http://www.itu.int/itu-t/workprog/wp_item.aspx?isn=14302) | Assessment framework for digital transformation of sectors in smart cities |
| [Y.4907](http://www.itu.int/itu-t/workprog/wp_item.aspx?isn=14949) | Reference architecture of blockchain-based unified KPI data management for smart sustainable cities |
| [Y.4908](https://www.itu.int/ITU-T/recommendations/rec.aspx?rec=14425) | Performance evaluation frameworks of e-health systems in the IoT |

**Supplements agreed**

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| --- | --- |
| **Supplement** | **Subject / Title** |
| [Y.Suppl.32 to ITU-T Y.4000 series](http://www.itu.int/itu-t/workprog/wp_item.aspx?isn=16686) | Smart sustainable cities - A guide for city leaders |
| [Y.Suppl.33 to ITU-T Y.4000 series](http://www.itu.int/itu-t/workprog/wp_item.aspx?isn=16685) | Smart sustainable cities - Master plan |
| [Y.Suppl.34 to ITU-T Y.4000 series](http://www.itu.int/itu-t/workprog/wp_item.aspx?isn=16687) | Smart sustainable cities - Setting the stage for stakeholders' engagement |
| [Y.Suppl.45 to ITU-T Y.4000 series](http://www.itu.int/itu-t/workprog/wp_item.aspx?isn=13668) | An overview of smart cities and communities and the role of information and communication technologies |
| [Y.Suppl.58](http://www.itu.int/itu-t/workprog/wp_item.aspx?isn=16426) | Internet of Things and smart cities and communities standards roadmap |
| [Y.Suppl.56](http://www.itu.int/itu-t/workprog/wp_item.aspx?isn=14498) | Use cases of smart cities and communities |
| [Y.Suppl.57 to ITU-T Y.4409](http://www.itu.int/itu-t/workprog/wp_item.aspx?isn=14964) | Implementation guidelines to Recommendation ITU-T Y.4409/Y.2070 |
| [Y.Suppl.69](http://www.itu.int/itu-t/workprog/wp_item.aspx?isn=16392) | Web based data model for IoT and smart city systems and services |

**3.3.3 Lead study group activities for Internet of things identification**

Study Group 20 has been designated as the Lead Study Group (LSG) for Internet of things identification in accordance with World Telecommunication Standardization Assembly (WTSA-16) Resolution 2.

As the lead study group for Internet of things identification, Study Group 20 is responsible for the study of the appropriate core Questions on Security, privacy, trust and identification for IoT and SC&C.

SG20 organized the following workshop:

* [Vienna Cybersecurity Week - Session on Connecting Smart Sustainable Cities with the Sustainable Development Goals](https://www.energypact.org/)

12 March 2019 (16h30 - 18h00), Vienna, Austria

* [DT4CC Episode #9: Addressing the Security Risks of Digital Transformation on IoT](https://www.itu.int/en/ITU-T/webinars/20211206/Pages/default.aspx)

Virtual, 6 December 2021

**Approved Recommendations**

| **Recommendation** | **Subject / Title** |
| --- | --- |
| [Y.4459](http://www.itu.int/itu-t/workprog/wp_item.aspx?isn=13703) | Digital entity architecture framework for IoT interoperability |
| [Y.4805](http://www.itu.int/itu-t/workprog/wp_item.aspx?isn=13671) | Identifier service requirements for the interoperability of Smart City applications |
| [Y.4806](http://www.itu.int/itu-t/workprog/wp_item.aspx?isn=13700) | Security capabilities supporting safety of the Internet of Things |
| [Y.4807](http://www.itu.int/itu-t/workprog/wp_item.aspx?isn=14656) | Agility by design for Telecommunications/ICT Systems Security used in the Internet of Things |
| [Y.4808](http://www.itu.int/itu-t/workprog/wp_item.aspx?isn=13702) | Digital entity architecture framework to combat counterfeiting in IoT |
| [Y.4809](http://www.itu.int/itu-t/workprog/wp_item.aspx?isn=14947) | Unified IoT Identifiers for intelligent transport systems |
| [Y.4810](http://www.itu.int/itu-t/workprog/wp_item.aspx?isn=16412) | Requirements of data security for the heterogeneous IoT devices |
| [Y.4811](http://www.itu.int/itu-t/workprog/wp_item.aspx?isn=16413) | Reference framework of converged service for identification and authentication for IoT devices in decentralized environment |

**3.3.4 Joint Coordination Activity on Internet of Things and Smart Cities and Communities (JCA-IoT and SC&C)**

Joint Coordination Activity on Internet of Things and Smart Cities and Communities (JCA-IoT and SC&C) held nine (9) meetings during this study period. The JCA-IoT and SC&C meetings were held in conjunction with the SG20 meeting.

JCA-IoT and SC&C meetings were held on:

|  |  |
| --- | --- |
| **Place, date** | **Reports** |
| Dubai, 16 March 2017 | [Report](https://www.itu.int/ifa/t/sftp/jcaiot/1703/Out/jca-iot-o-050_draft_report_March_2017.docx) |
| Geneva, 7 September 2017 | [Report](https://www.itu.int/ifa/t/sftp/jcaiot/1709/Out/jca-iot-o-052_draft_report_Sept_2017.docx) |
| Cairo, Egypt, 10 May 2018 | [Report](https://www.itu.int/ifa/t/sftp/jcaiot/1805/Out/jca-iot-o-053_draft_report_May_2018.docx) |
| Wuxi, China, 6 December 2018 | [Report](https://www.itu.int/ifa/t/sftp/jcaiot/1812/Out/jca-iotscc-o-055r1_draft_report_December_2018.docx) |
| Geneva, 10 April 2019 | [Report](https://www.itu.int/ifa/t/sftp/jcaiot/1904/Out/jca-iotscc-o-060_draft_report_April_2019.docx) |
| Geneva, 28 November 2019 | [Report](https://www.itu.int/ifa/t/sftp/jcaiot/1911/Out/jca-iotscc-o-061_draft_report_November_2019.docx) |
| Virtual, 26 June 2020 | [Report](https://www.itu.int/ifa/t/sftp/jcaiot/2006/Out/jca-iotscc-o-062_draft_report_June_2020.docx) |
| Virtual, 23 April 2021 | [Report](https://www.itu.int/ifa/t/sftp/jcaiot/2104/Out/jca-iotscc-o-063_draft_report_April_2021.docx) |
| Virtual, 07 October 2021 | [Report](https://www.itu.int/ifa/t/sftp/jcaiot/2110/Out/jca-iotscc-o-064_draft_report.docx) |

The JCA-IoT and SC&C Roadmap was converted into [Supplement ITU-T Y.Suppl.58](https://www.itu.int/ITU-T/recommendations/rec.aspx?rec=14176) “Internet of Things and smart cities and communities standards roadmap”.

The JCA-IoT and SC&C webpage can be found [here](https://www.itu.int/en/ITU-T/jca/iot/Pages/default.aspx).

**3.3.5 SG20 Regional Group for Eastern Europe, Central Asia and Transcaucasia (SG20RG-EECAT)**

During the SG20 meeting that took place on 13-23 March 2017 in Dubai, the SG20 Regional Group for Eastern Europe, Central Asia and Transcaucasia (SG20RG-EECAT) was created. Its first meeting was held in Saint Petersburg, Russian Federation on 20-21 June 2017. Its second meeting was held in Saint Petersburg, Russian Federation on 4-5 June 2018. Its third meeting was held in Minsk, Belarus on 26-28 February 2019. Its fourth meeting was held in Minsk, Belarus on 5 March 2020. Its fifth meeting was held in Minsk, Belarus on 16-18 March 2021.

|  |  |
| --- | --- |
| **Place, date** | **Reports** |
| Saint Petersburg, 20-21 June 2017 | [SG20RG-EECAT-R1](https://www.itu.int/md/meetingdoc.asp?lang=en&parent=T17-SG20RG.EECAT-R-0001) |
| Saint Petersburg, 4-5 June 2018 | [SG20RG-EECAT-R2](https://www.itu.int/md/meetingdoc.asp?lang=en&parent=T17-SG20RG.EECAT-R-0002) |
| Minsk, 26-28 February 2019 | [SG20RG-EECAT-R3](https://www.itu.int/md/meetingdoc.asp?lang=en&parent=T17-SG20RG.EECAT-R-0003) |
| Minsk, 5 March 2020 | [SG20RG-EECAT-R4](https://www.itu.int/md/meetingdoc.asp?lang=en&parent=T17-SG20RG.EECAT-R-0004) |
| Minsk, 16-18 March 2021 | [SG20RG-EECAT-R5](https://www.itu.int/md/meetingdoc.asp?lang=en&parent=T17-SG20RG.EECAT-R-0005) |

The SG20RG-EECAT webpage can be found [here](https://www.itu.int/en/ITU-T/studygroups/2017-2020/20/sg20rgeecat/Pages/default.aspx).

**3.3.6 SG20 Regional Group for the Latin America Region (SG20RG-LATAM)**

During the SG20 meeting that took place on 13-23 March 2017 in Dubai, the SG20 Regional Group for the Latin America Region (SG20RG-LATAM) was created. Its first meeting was held in Cartagena de Indias, Colombia on 20 April 2018. Its second meeting was held in San Salvador, El Salvador on 11-12 September 2019.

|  |  |
| --- | --- |
| **Place, date** | **Reports** |
| Cartagena de Indias, 20 April 2018 | [SG20RG-LATAM-R1](https://www.itu.int/md/meetingdoc.asp?lang=en&parent=T17-SG020RG.LATAM-R-0001) |
| San Salvador, 11-12 September 2019 | [SG20RG-LATAM-R2](https://www.itu.int/md/meetingdoc.asp?lang=en&parent=T17-SG020RG.LATAM-R-0002) |
| Virtual, 13-14 October 2020 | [SG20RG-LATAM-R3](https://www.itu.int/md/T17-SG020RG.LATAM-R-0003/en) |

The SG20RG-LATAM webpage can be found [here](https://www.itu.int/en/ITU-T/studygroups/2017-2020/20/sg20rglatam/Pages/default.aspx).

**3.3.7 SG20 Regional Group for the Africa Region (SG20RG-AFR)**

During the SG20 meeting that took place on 13-23 March 2017 in Dubai, the SG20 Regional Group for the Africa Region (SG20RG-AFR) was created. Its first meeting was held in Zanzibar, Tanzania on 10-11 April 2018. Its second meeting was held in Abuja, Nigeria on 27-29 August 2019. Its third meeting was held virtually on 03 June 2021.

|  |  |
| --- | --- |
| **Place, date** | **Reports** |
| Zanzibar, 10-11 April 2018 | [SG20RG-AFR-R1](https://www.itu.int/md/meetingdoc.asp?lang=en&parent=T17-SG20RG.AFR-R-0001) |
| Abuja, 27-29 August 2019 | [SG20RG-AFR-R2](https://www.itu.int/md/meetingdoc.asp?lang=en&parent=T17-SG20RG.AFR-R-0002) |
| Virtual, 3 June 2021 | [SG20RG-AFR-R3](https://www.itu.int/md/meetingdoc.asp?lang=en&parent=T17-SG20RG.AFR-R-0003) |

The SG20RG-AFR webpage can be found [here](https://www.itu.int/en/ITU-T/studygroups/2017-2020/20/sg20rgafr/Pages/default.aspx).

**3.3.8 SG20 Regional Group for the Arab Region (SG20RG-ARB)**

During the SG20 meeting that took place on 13-23 March 2017 in Dubai, the SG20 Regional Group for the Arab Region (SG20RG-ARB) was created.”. Its first meeting was held in Cairo, Egypt on 9‑10 August 2017. Its second meeting was held in Riyadh, Saudi Arabia on 19-20 November 2017. Its third meeting was held in Riyadh, Saudi Arabia on 7 October 2019.

|  |  |
| --- | --- |
| **Place, date** | **Reports** |
| Cairo, 9-10 August 2017 | [SG20RG-ARB-R1](https://www.itu.int/md/meetingdoc.asp?lang=en&parent=T17-SG20RG.ARB-R-0001) |
| Riyadh, 19-20 November 2017 | [SG20RG-ARB-R2](https://www.itu.int/md/meetingdoc.asp?lang=en&parent=T17-SG20RG.ARB-R-0002) |
| Riyadh, 7 October 2019 | [SG20RG-ARB-R3](https://www.itu.int/md/meetingdoc.asp?lang=en&parent=T17-SG20RG.ARB-R-0003) |

The SG20RG-ARB webpage can be found [here](https://www.itu.int/en/ITU-T/studygroups/2017-2020/20/sg20rgarb/Pages/default.aspx).

**3.3.9 Focus Group on Data Processing and Management to support IoT and Smart Cities & Communities (FG-DPM)**

The Focus Group on Data Processing and Management to support IoT and Smart Cities & Communities (FG-DPM) was established by ITU-T Study Group 20 at its meeting in Dubai, 13-23 March 2017.

The meetings of FG-DPM were held on:

|  |  |
| --- | --- |
| **Place, date** | **Reports** |
| Geneva, Switzerland, 17-19 July 2017 | [Report](https://extranet.itu.int/sites/itu-t/focusgroups/dpm/Output/DPM-O-012.docx?Web=1) |
| Geneva, Switzerland, 20-25 October 2017 | [Report](https://extranet.itu.int/sites/itu-t/focusgroups/dpm/Output/DPM-O-034R1.docx?Web=1) |
| Brussels, Belgium, 20-23 February 2018 | [Report](https://extranet.itu.int/sites/itu-t/focusgroups/dpm/Output/DPM-O-042.docx?Web=1) |
| Cairo, Egypt, 1-3 May 2018 | [Report](https://extranet.itu.int/sites/itu-t/focusgroups/dpm/Output/DPM-O-085.docx?d=w591f93e9621d48a0800101660d217e32) |
| Tunis, Tunisia, 17-20 September 2018 | [Report](https://extranet.itu.int/sites/itu-t/focusgroups/dpm/_layouts/15/WopiFrame.aspx?sourcedoc=%7bCA5CA022-EA35-4CA3-BC21-ED5B06E41097%7d&file=DPM-O-110R2.docx) |
| Bundang, Seoul, Korea (Rep.of) | [Report](https://extranet.itu.int/sites/itu-t/focusgroups/dpm/Output/DPM-O-136R1.docx?d=w5bf5aa644d39465e8691035a0ef99502) |
| Geneva, 3-7 April 2019 | [Report](https://extranet.itu.int/sites/itu-t/focusgroups/dpm/Output/DPM-O-165-R1.docx?d=wd4dc006fc3024d6cb8988d5759b15932) |
| Geneva, 15-19 July 2019 | [Final Report](https://extranet.itu.int/sites/itu-t/focusgroups/dpm/Output/DPM-O-187R1.docx?d=w94f280b796ca4109a3bd12dd5e63173d) |

Workshops on Data Processing and Management for IoT and Smart Cities & Communities were held on:

* [1st ITU Workshop on Data Processing and Management for IoT and Smart Cities & Communities](https://www.itu.int/en/ITU-T/Workshops-and-Seminars/20180219/Pages/default.aspx) (Brussels, 19 February 2018)
* [Second ITU Workshop on Data Processing and Management for IoT and Smart Cities & Communities New](https://www.itu.int/en/ITU-T/Workshops-and-Seminars/20180917/Pages/default.aspx) (Tunis, Tunisia, 17 September 2018)
* [Third ITU Workshop on Data Processing and Management for IoT and Smart Cities & Communities](https://www.itu.int/en/ITU-T/Workshops-and-Seminars/201901/Pages/default.aspx) (Bundang, Seoul, Korea (Rep.of), 14 January 2019)
* [Fourth ITU Workshop on Data Processing and Management for IoT and Smart Cities & Communities](https://www.itu.int/en/ITU-T/Workshops-and-Seminars/20190719/Pages/default.aspx) (Geneva, 19 July 2019)
* [5th ITU Workshop on Data Processing and Management for IoT and Smart Cities & Communities](https://www.itu.int/en/ITU-T/climatechange/dpm/05/Pages/default.aspx) (Geneva, 25 November 2019)

FG-DPM concluded its work on July 2019 and completed the following work items:

* [2019 Technical Specification D0.1 - Data Processing and Management for IoT and Smart Cities and Communities: Vocabulary](https://www.itu.int/pub/publications.aspx?lang=en&parent=T-FG-DPM-2019-0.1)
* [2019 Technical Report D0.2 - Data processing and management for IoT and smart cities and communities: methodology for data processing and management concept building](https://www.itu.int/pub/publications.aspx?lang=en&parent=T-FG-DPM-2019-0.2)
* [2019 Technical Specification D1.1 - Use case analysis and requirements for Data Processing and Management to support IoT and Smart Cities and Communities](https://www.itu.int/pub/publications.aspx?lang=en&parent=T-FG-DPM-2019-1.1)
* [2019 Technical Specification D2.1 - Data processing and management framework for IoT and smart cities and communities](https://www.itu.int/pub/publications.aspx?lang=en&parent=T-FG-DPM-2019-2.1)
* [2019 Technical Report D2.3 - Web based data model for IoT and smart city](https://www.itu.int/pub/publications.aspx?lang=en&parent=T-FG-DPM-2019-2.3)
* [2019 Technical Specification D3.2 - SensorThings API - Sensing](https://www.itu.int/pub/publications.aspx?lang=en&parent=T-FG-DPM-2019-3.2)
* [2019 Technical Specification D3.3 - Framework to support data interoperability in IoT environments](https://www.itu.int/pub/publications.aspx?lang=en&parent=T-FG-DPM-2019-3.3)
* [2019 Technical Report D3.5 - Overview of blockchain for supporting IoT and SC&C in DPM aspects](https://www.itu.int/pub/publications.aspx?lang=en&parent=T-FG-DPM-2019-3.5)
* [2019 Technical Specification D3.6 - Blockchain-based data exchange and sharing for supporting IoT and SC&C](https://www.itu.int/pub/publications.aspx?lang=en&parent=T-FG-DPM-2019-3.6)
* [2019 Technical Specification D3.7 - Blockchain-based data management for supporting IoT and SC&C](https://www.itu.int/pub/publications.aspx?lang=en&parent=T-FG-DPM-2019-3.7)
* [2019 Technical Specification D3.8 - Identity framework in blockchain to support DPM for IoT and SC&C](https://www.itu.int/pub/publications.aspx?lang=en&parent=T-FG-DPM-2019-3.8)
* [2019 Technical Report D4.1 - Framework for security, privacy, risk and governance in data processing and management](https://www.itu.int/pub/publications.aspx?lang=en&parent=T-FG-DPM-2019-4.1)
* [2019 Technical Report D4.3 - Overview of technical enablers for trusted data](https://www.itu.int/pub/publications.aspx?lang=en&parent=T-FG-DPM-2019-4.3)
* [2019 Technical Specification D4.4 - Framework to support data quality management in IoT](https://www.itu.int/pub/publications.aspx?lang=en&parent=T-FG-DPM-2019-4.4)
* [2019 Technical Specification D5 - Data economy: commercialization, ecosystem and impact assessment](https://www.itu.int/pub/publications.aspx?lang=en&parent=T-FG-DPM-2019-5)

The list of FG-DPM deliverables proposed to be assigned to ITU-T SG20 Questions was presented during the SG20 opening plenary held on 25 November 2019. The deliverables were discussed during the Questions sessions and the following has been agreed:

| **FG-DPM Deliverable** | **Question** | **Decision Taken** | **Work Item** | **Title** | **TD** |
| --- | --- | --- | --- | --- | --- |
| D2.1 - Data processing and management framework for IoT and smart cities and communities | 1/20 | A new work item was created to develop a Recommendation | Y.DPM-framework | Data processing and management framework for IoT and smart cities and communities | [TD1533-R2](https://www.itu.int/md/meetingdoc.asp?lang=en&parent=T17-SG20-191125-TD-GEN-1533) A.1 |
| D2.3 - Web based data model for IoT and smart city | 1/20 | A new work item was created to develop a Supplement | Y.Sup.Web-DM | Web based data model for IoT and smart city | [TD1534-R1](https://www.itu.int/md/meetingdoc.asp?lang=en&parent=T17-SG20-191125-TD-GEN-1534) A.13 |
| D3.3 - Framework to support data interoperability in IoT environments | 1/20 | A new work item was created to develop a Recommendation | Y.DPM-interop | Requirements and functional model to support data interoperability in IoT environments | [TD1545-R2](https://www.itu.int/md/meetingdoc.asp?lang=en&parent=T17-SG20-191125-TD-GEN-1545) A.1 |
| D4.4 - Framework to support data quality management in IoT | 1/20 | A new work item was created to develop a Recommendation | Y.DPM-qm | Requirements and functional model to support data quality management in IoT | [TD1546-R3](https://www.itu.int/md/meetingdoc.asp?lang=en&parent=T17-SG20-191125-TD-GEN-1546) A.1 |
| Part of D3.3 - Framework to support data interoperability in IoT environments | 4/20 | A new work item was created to develop a Recommendation taking into consideration part of D.3.3 from the FG-DPM and Recommendation ITU-T Y.4452 | Y.eHealth-Semantic | Architecture of web of objects based semantic mediation model in eHealth service | [TD1553-R1](https://www.itu.int/md/meetingdoc.asp?lang=en&parent=T17-SG20-191125-TD-GEN-1553) A.1  [[TD1552](https://www.itu.int/md/meetingdoc.asp?lang=en&parent=T17-SG20-191125-TD-GEN-1552)] |
| D3.7 - Blockchain-based data management for supporting IoT and SC&C | 4/20 | A new work item was created to develop a Recommendation | Y.DPM-BC-DM | Blockchain-based Data Management for supporting IoT and SC&C | [TD1568-R1](https://www.itu.int/md/meetingdoc.asp?lang=en&parent=T17-SG20-191125-TD-GEN-1568) A.1  [[TD1567](https://www.itu.int/md/meetingdoc.asp?lang=en&parent=T17-SG20-191125-TD-GEN-1567)] |
| D3.5 - Overview of blockchain for supporting IoT and SC&C in DPM aspects | 4/20 | A new work item was created to develop a Supplement | Y.Sup-DPM-OBC | Overview of blockchain for supporting IoT and SC&C in DPM aspects | [TD1570-R1](https://www.itu.int/md/meetingdoc.asp?lang=en&parent=T17-SG20-191125-TD-GEN-1570) A.13  [[TD1569](https://www.itu.int/md/meetingdoc.asp?lang=en&parent=T17-SG20-191125-TD-GEN-1569)] |
| D3.6 - Blockchain-based data exchange and sharing for supporting IoT and SC&C | 4/20 | A new work item was created to develop a Recommendation | Y.DPM-BC-ES | Blockchain-based data exchange and sharing for supporting IoT and SC&C | [TD1572](https://www.itu.int/md/meetingdoc.asp?lang=en&parent=T17-SG20-191125-TD-GEN-1572) A.1  [[TD1571](https://www.itu.int/md/meetingdoc.asp?lang=en&parent=T17-SG20-191125-TD-GEN-1571)] |
| D3.2 - SensorThings API - Sensing | 4/20 | A new work item was created to develop a Recommendation | Y.DPM-ST-API | SensorThings API - Sensing | [TD1574-R1](https://www.itu.int/md/meetingdoc.asp?lang=en&parent=T17-SG20-191125-TD-GEN-1574) A.1  [[TD1573](https://www.itu.int/md/meetingdoc.asp?lang=en&parent=T17-SG20-191125-TD-GEN-1573)] |

The FG-DPM webpage can be found [here](https://www.itu.int/en/ITU-T/focusgroups/dpm/Pages/default.aspx).

It should be noted that the following Recommendations and Supplements (based on the work of FG-DPM) were subsequently approved and agreed:

* Recommendation ITU-T Y.4473 “SensorThings API - Sensing”
* 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.4563 “Requirements and functional model to support data interoperability in IoT environments”
* Supplement ITU-T Y.Suppl.62 to ITU-T Y.4000 series “Overview of blockchain for supporting Internet of things and smart cities and communities in data processing and management aspects”
* Supplement ITU-T Y.Suppl.69 “Web based data model for IoT and smart city systems and services”

**3.4 Projects/ Other activities**

### 3.4.1 Green Standards Week

In accordance with World Telecommunication Standardization Assembly (WTSA-16) Resolution 98, which instructs the Director of the Telecommunication Standardization Bureau to provide assistance to promote quality standardization work in a timely manner, and promote participation in IoT and SC&C activities, ITU organized events and activities relevant to ITU-T Study Group 20 and related to Internet of things and smart sustainable cities, such as the Green Standards Week.

The Green Standards Week acts as a global platform where policymakers, field experts, city planners, regulators, standards experts, civil societies, and among others can come together to discuss the role of information communication technologies (ICTs) and frontier technologies in facilitating smart governance and smart sustainable cities.

During study period 2017-2021, the following Green Standards Weeks were held:

* 7th Green Standards Week

Manizales, Colombia, 3-5 April 2017

* 8th Green Standards Week

Zanzibar, Tanzania, 9-12 April 2018

* 9th Green Standards Week  
  Valencia, Spain, 1-4 October 2019
* 10th Green Standards Week

Virtual, 14-16 December 2021

More information available [here](https://www.itu.int/en/ITU-T/Workshops-and-Seminars/gsw/Pages/default.aspx).

### 3.4.2 United 4 Smart Sustainable Cities

World Telecommunication Standardization Assembly (WTSA-16) Resolution 98, instructs the Director of the Telecommunication Standardization Bureau to carry out, in collaboration with Member States and cities, pilot projects in cities related to SC&C key performance indicator (KPI) assessment activities, aimed at facilitating the deployment and implementation of IoT and SC&C standards worldwide; and to continue to support the United for Smart Sustainable Cities Initiative (U4SSC), launched by ITU together with the United Nations Economic Commission for Europe (UNECE) in May 2016, and share its deliverables with ITU-T Study Group 20 and other study groups concerned.

The “United for Smart Sustainable Cities” (U4SSC) is a UN initiative coordinated by ITU, UNECE and UN-Habitat, and supported by CBD, ECLAC, FAO, UNDP, UNECA, UNESCO, UNEP, UNEP-FI, UNFCCC, UNIDO, UNOP, UNU-EGOV, UN-Women and WMO to achieve Sustainable Development Goal 11: "Make cities and human settlements inclusive, safe, resilient and sustainable".

U4SSC serves as the global platform to advocate for public policy and to encourage the use of ICTs to facilitate and ease the transition to smart sustainable cities.

U4SSC has developed the key performance indicators (KPIs) for Smart Sustainable Cities (SSC) to support cities worldwide in evaluating the role and contribution of ICTs and digital technologies in enabling smart sustainable cities, and to provide cities with the tools for self-assessment with the objective of achieving the United Nations Sustainable Development Goals (SDGs). The U4SSC KPIs were based on Recommendation ITU-T Y.4903/L.1603 “Key performance indicators for smart sustainable cities to assess the achievement of sustainable development goals”, and are being implemented in over 150 cities worldwide.

Case studies developed on U4SSC KPIs includes:

* [Implementing ITU-T International Standards to Shape Smart Sustainable Cities: The Case of Moscow](https://www.itu.int/en/publications/Documents/tsb/2018-U4SSC-Case-of-Moscow/index.html#p=1)
* [Implementing ITU-T International Standards to Shape Smart Sustainable Cities: The Case of Singapore](https://www.itu.int/en/publications/Documents/tsb/2017-Implementing-ITU-T-International-Standards-to-Shape-Smart-Sustainable-Cities-The-Case-of-Singapore/index.html#p=1)
* [Implementing ITU-T International Standards to Shape Smart Sustainable Cities: The Case of Dubai](https://www.itu.int/en/publications/Documents/tsb/2016-DubaiCase/index.html#p=1)

City Snapshots developed on U4SSC KPIs includes:

* [Ålesund, Norway – Snapshot](https://www.itu.int/en/publications/Documents/tsb/2020-U4SSC-City-Snapshot-Alesund-Norway/index.html#p=1)
* [Bizerte, Tunisia – Snapshot](https://www.itu.int/en/publications/Documents/tsb/2019-U4SSC-City-Snapshot-Bizerte-Tunisia/index.html)
* [Moscow, Russia – Snapshot](https://www.itu.int/en/ITU-T/ssc/united/Documents/U4SSC-Snapshots/City_Snapshot_Moscow_Russia.pdf)
* [Riyadh, Saudi Arabia – Snapshot](https://www.itu.int/en/publications/Documents/tsb/2019-U4SSC-City-Snapshot-Riyadh-Saudi-Arabia/index.html)
* [Pully, Switzerland – Snapshot](https://www.itu.int/en/publications/Documents/tsb/2019-U4SSC-City-Snapshot-Pully-Switzerland/index.html)
* [Valencia, Spain – Snapshot](https://www.itu.int/en/publications/Documents/tsb/2020-U4SSC-City-Snapshot-Valencia-Spain/index.html)

* [Trondheim, Norway](https://www.itu.int/en/publications/Documents/tsb/2020-U4SSC-City-Snapshot-Trondheim-Norway/index.html)
* [Rana, Norway](https://www.itu.int/en/publications/Documents/tsb/2020-U4SSC-City-Snapshot-Rana-Norway/index.html)
* [Molde, Norway](https://www.itu.int/en/publications/Documents/tsb/2020-U4SSC-City-Snapshot-Molde-Norway/index.html)
* [Kristiansund, Norway](https://www.itu.int/en/publications/Documents/tsb/2020-U4SSC-City-Snapshot-Kristiansund-Norway/index.html)
* [Karmoy, Norway](https://www.itu.int/en/publications/Documents/tsb/2020-U4SSC-City-Snapshot-Karmoy-Norway/index.html)
* [Haugesund, Norway](https://www.itu.int/en/publications/Documents/tsb/2020-U4SSC-City-Snapshot-Haugesund-Norway/index.html)
* [Bodo, Norway](https://www.itu.int/en/publications/Documents/tsb/2020-U4SSC-City-Snapshot-Bodo-Norway/index.html)
* [Baerum, Norway](https://www.itu.int/en/publications/Documents/tsb/2020-U4SSC-City-Snapshot-Baerum-Norway/index.html)
* [Asker, Norway](https://www.itu.int/en/publications/Documents/tsb/2020-U4SSC-City-Snapshot-Asker-Norway/index.html)
* [Esperanza, Argentina](https://www.itu.int/en/publications/Documents/tsb/2020-U4SSC-City-Snapshot-Esperanza-Province-of-Santa-Fe-Argentina/index.html)
* [Santa Fe, Argentina](https://www.itu.int/en/publications/Documents/tsb/2020-U4SSC-City-Snapshot-Santa-Fe-Argentina/index.html)
* [Gjøvik, Norway](https://www.itu.int/en/publications/Documents/tsb/2020-U4SSC-City-Snapshot-Gjovik-Norway/index.html)
* [Wels, Austria](https://www.itu.int/en/publications/Documents/tsb/2020-U4SSC-City-Snapshot-Wels-Austria/index.html)
* [Kristiansand, Norway](https://www.itu.int/en/publications/Documents/tsb/2021-U4SSC-City-Snapshot-Kristiansand-Norway/index.html)
* [Stavanger, Norway](https://www.itu.int/en/publications/Documents/tsb/2021-U4SSC-City-Snapshot-Stavanger-Norway/index.html)
* [Aukra, Norway](https://www.itu.int/en/publications/Documents/tsb/2021-U4SSC-City-Snapshot-Aukra-Norway/index.html)
* [Aure, Norway](https://www.itu.int/en/publications/Documents/tsb/2021-U4SSC-City-Snapshot-Aure-Norway/index.html)
* [Averøy, Norway](https://www.itu.int/en/publications/Documents/tsb/2021-U4SSC-City-Snapshot-Averoy-Norway/index.html)
* [Fjord, Norway](https://www.itu.int/en/publications/Documents/tsb/2021-U4SSC-City-Snapshot-Fjord-Norway/index.html)
* [Gjemnes, Norway](https://www.itu.int/en/publications/Documents/tsb/2021-U4SSC-City-Snapshot-Gjemnes-Norway/index.html)
* [Hareid, Norway](https://www.itu.int/en/publications/Documents/tsb/2021-U4SSC-City-Snapshot-Hareid-Norway/index.html)
* [Herøy, Norway](https://www.itu.int/en/publications/Documents/tsb/2021-U4SSC-City-Snapshot-Heroy-Norway/index.html)
* [Hustadvika, Norway](https://www.itu.int/en/publications/Documents/tsb/2021-U4SSC-City-Snapshot-Hustadvika-Norway/index.html)
* [Ørsta, Norway](https://www.itu.int/en/publications/Documents/tsb/2021-U4SSC-City-Snapshot-Orsta-Norway/index.html)
* [Rauma, Norway](https://www.itu.int/en/publications/Documents/tsb/2021-U4SSC-City-Snapshot-Rauma-Norway/index.html)
* [Sande, Norway](https://www.itu.int/en/publications/Documents/tsb/2021-U4SSC-City-Snapshot-Sande-Norway/index.html)
* [Smøla, Norway](https://www.itu.int/en/publications/Documents/tsb/2021-U4SSC-City-Snapshot-Smola-Norway/index.html)
* [Stranda, Norway](https://www.itu.int/en/publications/Documents/tsb/2021-U4SSC-City-Snapshot-Stranda-Norway/index.html)
* [Sunndal, Norway](https://www.itu.int/en/publications/Documents/tsb/2021-U4SSC-City-Snapshot-Sunndal-Norway/index.html)
* [Surnadal, Norway](https://www.itu.int/en/publications/Documents/tsb/2021-U4SSC-City-Snapshot-Surnadal-Norway/index.html)
* [Sykkylven, Norway](https://www.itu.int/en/publications/Documents/tsb/2021-U4SSC-City-Snapshot-Sykkylven-Norway/index.html)
* [Tingvoll, Norway](https://www.itu.int/en/publications/Documents/tsb/2021-U4SSC-City-Snapshot-Tingvoll-Norway/index.html)
* [Ulstein, Norway](https://www.itu.int/en/publications/Documents/tsb/2021-U4SSC-City-Snapshot-Ulstein-Norway/index.html)
* [Vanylven, Norway](https://www.itu.int/en/publications/Documents/tsb/2021-U4SSC-City-Snapshot-Vanylven-Norway/index.html)
* [Vestnes, Norway](https://www.itu.int/en/publications/Documents/tsb/2021-U4SSC-City-Snapshot-Vestnes-Norway/index.html)
* [Volda, Norway](https://www.itu.int/en/publications/Documents/tsb/2021-U4SSC-City-Snapshot-Volda-Norway/index.html)
* [More and Romsdal, Norway](https://www.itu.int/pub/publications.aspx?lang=en&parent=T-TUT-SMARTCITY-2021-27)
* [Mashhad, Iran](https://www.itu.int/en/publications/Documents/tsb/2021-U4SSC-City-Snapshot-Mashhad-Iran/index.html)
* [Larvik, Norway](https://www.itu.int/en/publications/Documents/tsb/2021-U4SSC-City-Snapshot-Larvik-Norway/index.html#p=1)
* [Daegu, Korea (Republic of)](https://www.itu.int/en/publications/Documents/tsb/2021-U4SSC-City-Snapshot-Daegu-Republic-of-Korea/index.html#p=1)

City Verification Reports developed on U4SSC KPIs includes:

* [Ålesund, Norway – Verification report](https://www.itu.int/en/publications/Documents/tsb/2020-U4SSC-Verification-Report-Alesund-Norway/index.html)
* [Bizerte, Tunisia – Verification report](https://www.itu.int/en/publications/Documents/tsb/2020-U4SSC-Verification-Report-Bizerte-Tunisia/index.html)
* [Krimpen aan den Ijssel, The Netherlands – Verification report](https://www.itu.int/en/publications/Documents/tsb/2020-U4SSC-Verification-Report-Krimpen-aan-den-IJssel-The-Netherlands/index.html)
* Riyadh, Saudi Arabia – Verification report
* [Pully, Switzerland – Verification report](https://www.itu.int/en/ITU-T/ssc/united/Documents/pully-under-the-microscope-u4ssc-E.pdf)
* [Valencia, Spain – Verification report](https://www.itu.int/en/publications/Documents/tsb/2020-U4SSC-Verification-Report-Valencia-Spain/index.html)

* [Trondheim, Norway](https://www.itu.int/en/publications/Documents/tsb/2020-U4SSC-Verification-Report-Trondheim-Norway/index.html)
* [Rana, Norway](https://www.itu.int/en/publications/Documents/tsb/2020-U4SSC-Verification-Report-Rana-Norway/index.html)
* [Molde, Norway](https://www.itu.int/en/publications/Documents/tsb/2020-U4SSC-Verification-Report-Molde-Norway/index.html)
* [Kristiansund, Norway](https://www.itu.int/en/publications/Documents/tsb/2020-U4SSC-Verification-Report-Kristiansund-Norway/index.html)
* [Karmoy, Norway](https://www.itu.int/en/publications/Documents/tsb/2020-U4SSC-Verification-Report-Karmoy-Norway/index.html)
* [Haugesund, Norway](https://www.itu.int/en/publications/Documents/tsb/2020-U4SSC-Verification-Report-Haugesund-Norway/index.html)
* [Bodo, Norway](https://www.itu.int/en/publications/Documents/tsb/2020-U4SSC-Verification-Report-Bodo-Norway/index.html)
* [Baerum, Norway](https://www.itu.int/en/publications/Documents/tsb/2020-U4SSC-Verification-Report-Baerum-Norway/index.html)
* [Asker, Norway](https://www.itu.int/en/publications/Documents/tsb/2020-U4SSC-Verification-Report-Asker-Norway/index.html)
* [Esperanza, Argentina](https://www.itu.int/en/publications/Documents/tsb/2020-U4SSC-Verification-Report-Esperanza-Province-of-Santa-Fe-Argentina/index.html)
* [Santa Fe, Argentina](https://www.itu.int/en/publications/Documents/tsb/2020-U4SSC-Verification-Report-Santa-Fe-Argentina/index.html)
* [Gjøvik, Norway](https://www.itu.int/en/publications/Documents/tsb/2020-U4SSC-Verification-Report-Gjovik-Norway/index.html)
* [Kristiansand, Norway](https://www.itu.int/en/publications/Documents/tsb/2021-U4SSC-Verification-Report-Kristiansand-Norway/index.html)
* [Stavanger, Norway](https://www.itu.int/en/publications/Documents/tsb/2021-U4SSC-Verification-Report-Stavanger-Norway/index.html)
* [Mashhad, Iran](https://www.itu.int/en/publications/Documents/tsb/2021-U4SSC-Verification-Report-Mashhad-Iran/index.html)
* [Larvik, Norway](https://www.itu.int/en/publications/Documents/tsb/2021-U4SSC-Verification-Report-Larvik-Norway/index.html#p=1)
* [Daegu, Korea (Republic of)](https://www.itu.int/en/publications/Documents/tsb/2021-U4SSC-Verification-Report-Daegu-Republic-of-Korea/index.html#p=1)

City Factsheets developed on U4SSC KPIs includes:

* [Ålesund, Norway – Factsheet](https://www.itu.int/en/publications/Documents/tsb/2020-U4SSC-Factsheet-Alesund-Norway/index.html)
* [Bizerte, Tunisia – Factsheet](https://www.itu.int/en/publications/Documents/tsb/2020-U4SSC-Factsheet-Bizerte-Tunisia/index.html)
* [Riyadh, Saudi Arabia – Factsheet](https://www.itu.int/en/publications/Documents/tsb/2020-U4SSC-Factsheet-Riyadh-Saudi-Arabia/index.html)
* [Pully, Switzerland – Factsheet](https://www.itu.int/en/publications/Documents/tsb/2020-U4SSC-Factsheet-Pully-Switzerland/index.html)
* [Valencia, Spain – Factsheet](https://www.itu.int/en/publications/Documents/tsb/2020-U4SSC-Factsheet-Valencia-Spain/index.html)
* [Mashhad, Iran - Factsheet](https://www.itu.int/en/publications/Documents/tsb/2021-U4SSC-Factsheet-Mashhad-Iran-Islamic-Republic-of/index.html#p=1)

Ongoing work (Verification Reports) includes:

* Narvik, Norway
* Tromso, Norway

Ongoing work (Snapshots) includes:

* Narvik, Norway
* Tromso, Norway

Ongoing work (Case study) include:

* Daegu, Korea

More information available [here](https://www.itu.int/en/ITU-T/ssc/united/Pages/default.aspx).

**Reports and publications**

In accordance with World Telecommunication Standardization Assembly (WTSA-16) Resolution 98, which instructs the Director of the Telecommunication Standardization Bureau to continue to support U4SSC and share its deliverables with concerned ITU-T study groups, the following U4SSC deliverables have been shared as a TD during SG20 meetings:

* [Collection Methodology for Key Performance Indicators for Smart Sustainable Cities](https://www.itu.int/en/publications/Documents/tsb/2017-U4SSC-Collection-Methodology/index.html)
* [Implementing SDG11 by connecting sustainability policies and urban-planning practices through ICTs](https://www.itu.int/en/publications/Documents/tsb/2017-U4SSC-Implementing-sustainable-devt/index.html)
* [Enhancing innovation and participation in smart sustainable cities](https://www.itu.int/en/publications/Documents/tsb/2017-U4SSC-Enhancing-innovation/index.html)
* [Connecting cities and communities with the Sustainable Development Goals](https://www.itu.int/en/publications/Documents/tsb/2017-U4SSC-Deliverable-Connecting-Cities/index.html)
* [City Science Application Framework](https://www.itu.int/en/publications/Documents/tsb/2019-U4SSC-City-Science-Application-Framework/index.html) and its 8 Case Studies
  + [Air quality management in Southern California, USA](https://www.itu.int/en/publications/Documents/tsb/2019-U4SSC-Air-quality-management-in-Southern-California-USA/index.html)
  + [Smart Dubai Happiness Meter in Dubai, United Arab Emirates](https://www.itu.int/en/publications/Documents/tsb/2019-U4SSC-Smart-Dubai-Happiness-Meter-in-Dubai-United-Arab-Emirates/index.html)
  + [Crime prediction for more agile policing in cities - Rio de Janeiro, Brazil](https://www.itu.int/en/publications/Documents/tsb/2019-U4SSC-Crime-prediction-for-more-agile-policing-in-cities-Rio-de-Janeiro-Brazil/index.html)
  + [Data driven energy savings in the Hyperdome shopping centre in Queensland, Australia](https://www.itu.int/en/publications/Documents/tsb/2019-U4SSC-Data-driven-energy-savings-in-the-Hyperdome-shopping-centre-in-Queensland-Australia/index.html)
  + [Fine dust filtration in Stuttgart, Germany](https://www.itu.int/en/publications/Documents/tsb/2019-U4SSC-Fine-dust-filtration-in-Stuttgart-Germany/index.html)
  + [Smart Dubai - Rashid - City Concierge](https://www.itu.int/en/publications/Documents/tsb/2019-U4SSC-Smart-Dubai-Rashid-City-Concierge/index.html)
  + [Identifying the cascading effects on vital objects during flooding](https://www.itu.int/en/publications/Documents/tsb/2019-U4SSC-Identifying-the-cascading-effects-on-vital-objects-during-flooding/index.html)
  + [Unlocking the potential of trust-based AI for city science and smart cities](https://www.itu.int/en/publications/Documents/tsb/2019-U4SSC-Unlocking-the-potential-of-trust-based-AI-for-city-science-and-smarter-cities/index.html)
* [A Guide to Circular Cities](https://www.itu.int/en/publications/Documents/tsb/2020-U4SSC-A-guide-to-circular-cities/index.html) and its 8 Case studies
  + [Energy Efficiency in Buildings](https://www.itu.int/en/publications/Documents/tsb/2020-U4SSC-Case-study-Energy-efficiency-in-buildings/index.html)
  + [City Solid Waste Management](https://www.itu.int/en/publications/Documents/tsb/2020-U4SSC-Case-study-City-solid-waste-management/index.html)
  + [Affordable Housing and Social Inclusion](https://www.itu.int/en/publications/Documents/tsb/2020-U4SSC-Case-study-Affordable-housing-and-social-inclusion/index.html)
  + [Urban Mobility](https://www.itu.int/en/publications/Documents/tsb/2020-U4SSC-Case-study-Urban-mobility/index.html)
  + [Re-use of Consumer Goods and Tools Loaning](https://www.itu.int/en/publications/Documents/tsb/2020-U4SSC-Case-study-Re-use-of-consumer-goods-and-tools-loaning/index.html)
  + [Reducing Food Waste](https://www.itu.int/en/publications/Documents/tsb/2020-U4SSC-Case-study-Reducing-food-waste/index.html)
  + [Participatory Urban Planning](https://www.itu.int/en/publications/Documents/tsb/2020-U4SSC-Case-study-Participatory-urban-planning/index.html)
  + [Circularity to Promote Local Businesses and Digitization](https://www.itu.int/en/publications/Documents/tsb/2020-U4SSC-Case-study-Circularity-to-promote-local-businesses-and-digitization/index.html)
* [Accelerating city transformation using frontier technologies](https://www.itu.int/en/publications/Documents/tsb/2020-U4SSC-Deliverable-Accelerating-city-transformation/index.html)
* [Blockchain for smart sustainable cities](https://www.itu.int/en/publications/Documents/tsb/2020-U4SSC-Blockchain-for-smart-sustainable-cities/index.html)
* [Simple ways to be smart](https://www.itu.int/en/publications/Documents/tsb/2021-U4SSC-Simple-ways-to-be-smart/index.html)
* [Guidelines on tools and mechanisms to finance smart sustainable cities projects](https://www.itu.int/en/publications/Documents/tsb/2021-A-U4SSC-deliverable-Guidelines-on-tools-and-mechanisms-to-finance-SSC-projects/index.html)
* [Digital solutions for integrated city management and use cases](https://www.itu.int/en/publications/Documents/tsb/2021-U4SSC-Digital-solutions-for-integrated-city-management-and-use-cases/index.html#p=1)
* [Compendium of survey results on integrated digital solutions for city platforms around the world](https://www.itu.int/en/publications/Documents/tsb/2021-U4SSC-Compendium-of-survey-results/index.html#p=1)
* [Smart public health emergency management and ICT implementations](https://www.itu.int/en/publications/Documents/tsb/2021-U4SSC-Smart-public-health-emergency-management-and-ICT-implementations/index.html#p=1)

Please find all U4SSC deliverables available [here](https://www.itu.int/en/ITU-T/ssc/united/Pages/publications-U4SSC.aspx).

The U4SSC initiative is working on the following Thematic Groups:

* City Platforms
* Lessons learned from building urban economic resilience at city level during and after COVID-19
* Compendium of Practices on Innovative Financing for Smart Sustainable Cities Projects
* Guiding principles for artificial intelligence in cities
* Procurement Guidelines for Smart Sustainable Cities
* Digital Transformation for People-Oriented Cities

Additional information can be found [here](https://www.itu.int/en/ITU-T/ssc/united/Pages/default.aspx).

**3.5 Bridging the standardization gap**

Under WTSA-16 Resolution 44 (Rev. Hammamet, 2016) - *Bridging the standardization gap between developing and developed countries*, SG20 organizes a hands-on training session for delegates from developing countries during its study group meetings. The training sessionsencourage delegates from developing countries to be more actively involved in ITU-T Study Group activities and to share strategies and tips for drafting effective Contributions.

ITU-T SG20 organized a Bridging the Standardization Gap (BSG) Training on 6 May 2018, 25 November 2019, 17 June 2020, 06 May 2021 and 04 October 2021. In addition, a BSG training took place on 27 August 2019 during the 1st Digital Africa week in conjunction with the meeting of the ITU-T Study Group 20 Regional Group for Africa (ITU-T SG20RG-AFR). ITU-T SG20 also organized Bridging the Standardization Gap (BSG) Trainings before ITU-T SG20 meetings.

# 4 Observations concerning future work

Study Group 20’s work on evolving emerging digital technologies, including IoT– and its overall potential, along with the need to address challenges around interoperability, security, accessibility, data considerations, etc. – is essential to enabling the continued development of smart cities, smart villages and communities.

Emerging digital technologies, such as IoT, Artificial Intelligence (AI), machine learning, digital twins, blockchain, digitalization and Big Data, can offer innovative real solutions to meet the needs of the world’s population, the majority of which is increasingly found in cities. It is vitally important, therefore, that continual research into and assessment of the potential of emerging technologies and the extent of their scalability potential continue to be prioritized. Collating global best practices, developing technical standards and offering guidance on the optimal deployment of these technologies could, especially, help cities in developing countries make faster progress along their sustainable development pathways and, thereby, in achieving the UN Sustainable Development Goals and accelerating their digital transformation.

# 5 Updates to the WTSA Resolution 2 for the 2022-2024 study period

Annex 2 contains the updates to WTSA Resolution 2 proposed by Study Group 20 concerning the title, general areas of study, mandate, lead roles and points of guidance in the next study period.

ANNEX 1 **List of Recommendations, Supplements and  
other materials produced or deleted during the study period**

The list of new and revised Recommendations approved during the study period is found in Table 7.

The list of Recommendations determined/consented at the last meeting of Study Group 20 is found in Table 8.

The list of Recommendations deleted by Study Group 20 during the study period is found in Table 9.

The List of Recommendations submitted by Study Group 20 to WTSA-20 for approval is found in Table 10.

Tables 11 onwards list other publications approved and/or deleted by Study Group 20 during the study period.

**TABLE 7  
Study Group 20 – Recommendations approved during the study period**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Recommendation** | **Approval** | **Status** | **TAP/AAP** | **Title (English)** |
| [Y.4003](http://handle.itu.int/11.1002/1000/13634) | 2018-06-29 | In force | AAP | Overview of smart manufacturing in the context of the industrial Internet of things |
| [Y.4004](http://www.itu.int/itu-t/workprog/wp_item.aspx?isn=16409) | 2021-11-29 | In force | AAP | Overview of smart oceans and seas, and requirements for their ICT implementations |
| [Y.4051](http://handle.itu.int/11.1002/1000/13855) | 2019-07-07 | In force | AAP | Vocabulary for smart cities and communities |
| [Y.4101/Y.2067](http://handle.itu.int/11.1002/1000/13384) | 2017-10-29 | In force | AAP | Common requirements and capabilities of a gateway for Internet of things applications |
| [Y.4114](http://handle.itu.int/11.1002/1000/13265) | 2017-07-07 | In force | AAP | Specific requirements and capabilities of the Internet of things for big data |
| [Y.4115](http://handle.itu.int/11.1002/1000/13266) | 2017-04-29 | In force | AAP | Reference architecture for IoT device capability exposure |
| [Y.4116](http://handle.itu.int/11.1002/1000/13385) | 2017-10-29 | In force | AAP | Requirements of transportation safety services including use cases and service scenarios |
| [Y.4117](http://handle.itu.int/11.1002/1000/13386) | 2017-10-29 | In force | AAP | Requirements and capabilities of the Internet of things for support of wearable devices and related services |
| [Y.4118](http://handle.itu.int/11.1002/1000/13496) | 2018-06-06 | In force | AAP | Internet of things requirements and technical capabilities for support of accounting and charging |
| [Y.4119](http://handle.itu.int/11.1002/1000/13497) | 2018-03-01 | In force | AAP | Requirements and capability framework for IoT-based automotive emergency response system |
| [Y.4120](http://handle.itu.int/11.1002/1000/13635) | 2018-06-29 | In force | AAP | Requirements of Internet of things applications for smart retail stores |
| [Y.4121](http://handle.itu.int/11.1002/1000/13636) | 2018-06-29 | In force | AAP | Requirements of an Internet of things enabled network for support of applications for global processes of the Earth |
| [Y.4122](http://handle.itu.int/11.1002/1000/14735) | 2021-07-14 | In force | AAP | Requirements and capability framework of the edge-computing-enabled gateway in the Internet of things |
| [Y.4123](http://www.itu.int/itu-t/workprog/wp_item.aspx?isn=16655) | 2022-01-13 | In force | AAP | Requirements and capability framework of smart shopping mall system |
| [Y.4200](http://handle.itu.int/11.1002/1000/13387) | 2018-02-06 | In force | AAP | Requirements for the interoperability of smart city platforms |
| [Y.4201](http://handle.itu.int/11.1002/1000/13388) | 2018-02-06 | In force | AAP | High-level requirements and reference framework of smart city platforms |
| [Y.4202](http://handle.itu.int/11.1002/1000/13856) | 2019-02-13 | In force | AAP | Framework of wireless power transmission application service |
| [Y.4203](http://handle.itu.int/11.1002/1000/13857) | 2019-02-13 | In force | AAP | Requirements of things description in the Internet of things |
| [Y.4204](http://handle.itu.int/11.1002/1000/13858) | 2019-02-13 | In force | AAP | Accessibility requirements for the Internet of things applications and services |
| [Y.4205](http://handle.itu.int/11.1002/1000/13859) | 2019-02-13 | In force | AAP | Requirements and reference model of IoT-related crowdsourced systems |
| [Y.4206](http://handle.itu.int/11.1002/1000/13919) | 2019-06-13 | In force | AAP | Requirements and capabilities of user-centric work space service |
| [Y.4207](http://handle.itu.int/11.1002/1000/13920) | 2019-06-13 | In force | AAP | Requirements and capability framework of smart environmental monitoring |
| [Y.4208](http://handle.itu.int/11.1002/1000/14162) | 2020-01-13 | In force | AAP | Internet of things requirements for support of edge computing |
| [Y.4209](http://handle.itu.int/11.1002/1000/14163) | 2020-04-06 | In force | AAP | Requirements for interoperation of the smart port with the smart city |
| [Y.4210](http://www.itu.int/itu-t/workprog/wp_item.aspx?isn=14500) | 2020-08-29 | In force | AAP | Requirements and use cases for universal communication module of mobile IoT devices |
| [Y.4211](http://handle.itu.int/11.1002/1000/14577) | 2020-12-14 | In force | AAP | Accessibility requirements for smart public transport services |
| [Y.4212](http://www.itu.int/itu-t/workprog/wp_item.aspx?isn=14106) | 2021-11-29 | In force | AAP | Requirements and capabilities of network connectivity management in the Internet of things |
| [Y.4213](http://www.itu.int/itu-t/workprog/wp_item.aspx?isn=14960) | 2021-11-29 | In force | AAP | Internet of things requirements and capability framework for monitoring physical city assets |
| [Y.4214](https://www.itu.int/ITU-T/workprog/wp_search.aspx?isn_task=16654) | 2022-02-03 | In force | TAP | Requirements of IoT-based civil engineering infrastructure health monitoring system |
| [Y.4215](https://www.itu.int/ITU-T/workprog/wp_search.aspx?isn_task=14303) | 2022-02-03 | In force | TAP | Use cases, requirements and capabilities of unmanned aircraft systems for the Internet of Things |
| [Y.4415](http://handle.itu.int/11.1002/1000/13637) | 2018-06-29 | In force | AAP | Architecture of web of objects-based virtual home network |
| [Y.4416](http://handle.itu.int/11.1002/1000/13638) | 2018-06-29 | In force | AAP | Architecture of the Internet of things based on next generation network evolution |
| [Y.4417](http://handle.itu.int/11.1002/1000/13639) | 2018-06-29 | In force | AAP | Framework of self-organization network in Internet of things environments |
| [Y.4418](http://handle.itu.int/11.1002/1000/13640) | 2018-06-29 | In force | AAP | Gateway functional architecture for Internet of things applications |
| [Y.4419](http://handle.itu.int/11.1002/1000/14736) | 2021-07-14 | In force | AAP | Requirements and capability framework of smart utility metering (SUM) |
| [Y.4420](http://handle.itu.int/11.1002/1000/14737) | 2021-07-14 | In force | AAP | Framework of Internet of things based monitoring and management for lifts |
| [Y.4421](http://www.itu.int/itu-t/workprog/wp_item.aspx?isn=14653) | 2021-10-11 | In force | TAP | Functional architecture for unmanned aerial vehicles and unmanned aerial vehicle controllers using IMT-2020 networks |
| [Y.4455](http://handle.itu.int/11.1002/1000/13389) | 2017-10-29 | In force | AAP | Reference architecture for Internet of things network service capability exposure |
| [Y.4456](http://handle.itu.int/11.1002/1000/13498) | 2018-03-01 | In force | AAP | Requirements and functional architecture for smart parking lots in smart cities |
| [Y.4457](http://handle.itu.int/11.1002/1000/13641) | 2018-06-29 | In force | AAP | Architectural framework for transportation safety services |
| [Y.4458](http://handle.itu.int/11.1002/1000/13860) | 2019-06-06 | In force | AAP | Requirements and functional architecture of a smart street light service |
| [Y.4459](http://handle.itu.int/11.1002/1000/13861) | 2020-01-12 | In force | AAP | Digital entity architecture framework for Internet of things interoperability |
| [Y.4460](http://handle.itu.int/11.1002/1000/13921) | 2019-06-13 | In force | AAP | Architectural reference models of devices for Internet of things applications |
| [Y.4461](http://handle.itu.int/11.1002/1000/14164) | 2020-01-13 | In force | AAP | Framework of open data in smart cities |
| [Y.4462](http://handle.itu.int/11.1002/1000/14165) | 2020-01-13 | In force | AAP | Requirements and functional architecture of open IoT identity correlation service |
| [Y.4463](http://handle.itu.int/11.1002/1000/14166) | 2020-01-13 | In force | AAP | Framework of delegation service for Internet of things devices |
| [Y.4464](http://handle.itu.int/11.1002/1000/14167) | 2020-01-13 | In force | AAP | Framework of blockchain of things as decentralized service platform |
| [Y.4465](http://handle.itu.int/11.1002/1000/14168) | 2020-01-13 | In force | AAP | Framework of Internet of things services based on visible light communications |
| [Y.4466](http://handle.itu.int/11.1002/1000/14169) | 2020-01-13 | In force | AAP | Framework of smart greenhouse service |
| [Y.4467](http://handle.itu.int/11.1002/1000/14170) | 2020-01-13 | In force | AAP | Minimum set of data structure for automotive emergency response system |
| [Y.4468](http://handle.itu.int/11.1002/1000/14171) | 2020-01-13 | In force | AAP | Minimum set of data transfer protocol for automotive emergency response system |
| [Y.4469](http://www.itu.int/itu-t/workprog/wp_item.aspx?isn=14654) | 2020-08-29 | In force | AAP | Reference architecture of spare computational capability exposure of IoT devices for smart home |
| [Y.4470](http://www.itu.int/itu-t/workprog/wp_item.aspx?isn=14503) | 2020-08-29 | In force | AAP | Reference architecture of artificial intelligence service exposure for smart sustainable cities |
| [Y.4471](https://www.itu.int/itu-t/workprog/wp_item.aspx?isn=14652) | 2021-05-17 | In force | TAP | Functional architecture of network-based driving assistance for autonomous vehicles |
| [Y.4472](https://www.itu.int/ITU-T/workprog/wp_item.aspx?isn=14297) | 2020-08-29 | In force | AAP | Open data application programming interface (APIs) for IoT data in smart cities and communities |
| [Y.4473](https://www.itu.int/ITU-T/workprog/wp_item.aspx?isn=16403) | 2020-08-29 | In force | AAP | SensorThings API - Sensing |
| [Y.4474](http://www.itu.int/itu-t/workprog/wp_item.aspx?isn=16397) | 2020-08-29 | In force | AAP | Functional architecture for IoT services based on Visible Light Communications |
| [Y.4475](http://www.itu.int/itu-t/workprog/wp_item.aspx?isn=14332) | 2020-08-29 | In force | AAP | Lightweight intelligent software framework for IoT devices |
| [Y.4476](http://www.itu.int/itu-t/workprog/wp_item.aspx?isn=14962) | 2021-02-06 | In force | AAP | OID-based resolution framework for transaction of distributed ledger assigned to IoT resources |
| [Y.4477](http://www.itu.int/itu-t/workprog/wp_item.aspx?isn=13709) | 2021-11-29 | In force | AAP | Framework of service interworking with device discovery and management in heterogeneous Internet of things environments |
| [Y.4478](http://www.itu.int/itu-t/workprog/wp_item.aspx?isn=15094) | 2021-11-29 | In force | AAP | Requirements and functional architecture for smart construction site services |
| [Y.4480](http://www.itu.int/itu-t/workprog/wp_item.aspx?isn=17210) | 2021-11-29 | In force | AAP | Low power protocol for wide area wireless networks |
| [Y.4500.1](http://handle.itu.int/11.1002/1000/13390) | 2018-01-13 | In force | AAP | oneM2M – Functional architecture |
| [Y.4500.2](http://handle.itu.int/11.1002/1000/13499) | 2018-05-06 | In force | TAP | oneM2M – Requirements |
| [Y.4500.4](http://handle.itu.int/11.1002/1000/13500) | 2018-03-01 | In force | AAP | oneM2M – Service layer core protocol specification |
| [Y.4500.5](http://handle.itu.int/11.1002/1000/13501) | 2018-03-01 | In force | AAP | oneM2M management enablement (OMA) |
| [Y.4500.6](http://handle.itu.int/11.1002/1000/13502) | 2018-03-01 | In force | AAP | oneM2M management enablement (BBF) |
| [Y.4500.8](http://handle.itu.int/11.1002/1000/13503) | 2018-03-01 | In force | AAP | oneM2M – CoAP protocol binding |
| [Y.4500.9](http://handle.itu.int/11.1002/1000/13504) | 2018-03-01 | In force | AAP | oneM2M – HTTP protocol binding |
| [Y.4500.10](http://handle.itu.int/11.1002/1000/13505) | 2018-03-01 | In force | AAP | oneM2M – MQTT protocol binding |
| [Y.4500.11](http://handle.itu.int/11.1002/1000/13506) | 2018-03-01 | In force | AAP | oneM2M – Common terminology |
| [Y.4500.12](http://handle.itu.int/11.1002/1000/13507) | 2018-03-01 | In force | AAP | oneM2M base ontology |
| [Y.4500.13/Q.3954](http://handle.itu.int/11.1002/1000/13508) | 2018-03-01 | In force | AAP | oneM2M – Interoperability testing |
| [Y.4500.14](http://handle.itu.int/11.1002/1000/13509) | 2018-03-01 | In force | AAP | oneM2M – LwM2M interworking |
| [Y.4500.15/Q.3955](http://handle.itu.int/11.1002/1000/13510) | 2018-03-01 | In force | AAP | oneM2M – Testing framework |
| [Y.4500.20](http://handle.itu.int/11.1002/1000/13511) | 2018-03-01 | In force | AAP | oneM2M – WebSocket protocol binding |
| [Y.4500.22](http://handle.itu.int/11.1002/1000/13512) | 2018-03-01 | In force | AAP | oneM2M – Field device configuration |
| [Y.4500.23](http://handle.itu.int/11.1002/1000/13513) | 2018-03-01 | In force | AAP | oneM2M – Home appliances information model and mapping |
| [Y.4500.32](http://handle.itu.int/11.1002/1000/13642) | 2018-06-29 | In force | AAP | oneM2M – MAF and MEF interface specification |
| [Y.4555](http://handle.itu.int/11.1002/1000/13862) | 2019-02-13 | In force | AAP | Service functionalities of self-quantification over Internet of things |
| [Y.4556](http://handle.itu.int/11.1002/1000/13863) | 2019-12-06 | In force | AAP | Requirements and functional architecture of smart residential community |
| [Y.4558](http://www.itu.int/itu-t/workprog/wp_item.aspx?isn=15090) | 2020-08-29 | In force | AAP | Requirements and functional architecture of smart fire smoke detection service |
| [Y.4559](https://www.itu.int/ITU-T/workprog/wp_item.aspx?isn=15092) | 2020-12-16 | In force | TAP | Requirements and functional architecture of base station inspection services using unmanned aerial vehicles |
| [Y.4560](http://www.itu.int/itu-t/workprog/wp_item.aspx?isn=16401) | 2020-08-29 | In force | AAP | Blockchain-based data exchange and sharing for supporting Internet of things and smart cities and communities |
| [Y.4561](http://www.itu.int/itu-t/workprog/wp_item.aspx?isn=16402) | 2020-08-29 | In force | AAP | Blockchain-based Data Management for supporting Internet of things and smart cities and communities |
| [Y.4562](http://www.itu.int/itu-t/workprog/wp_item.aspx?isn=14100) | 2021-12-14 | In force | AAP | Functions and metadata of spatiotemporal information service for smart cities |
| [Y.4563](http://www.itu.int/itu-t/workprog/wp_item.aspx?isn=16393) | 2021-11-29 | In force | AAP | Requirements and functional model to support data interoperability in IoT environments |
| [Y.4805](http://handle.itu.int/11.1002/1000/13267) | 2017-08-22 | In force | AAP | Identifier service requirements for the interoperability of smart city applications |
| [Y.4806](http://handle.itu.int/11.1002/1000/13391) | 2017-11-13 | In force | AAP | Security capabilities supporting safety of the Internet of things |
| [Y.4807](http://handle.itu.int/11.1002/1000/14172) | 2020-01-13 | In force | AAP | Agility by design for telecommunication/ICT systems security used in the Internet of things |
| [Y.4808](http://www.itu.int/itu-t/workprog/wp_item.aspx?isn=13702) | 2020-08-29 | In force | AAP | Digital entity architecture framework to combat counterfeiting in IoT |
| [Y.4809](http://www.itu.int/itu-t/workprog/wp_item.aspx?isn=14947) | 2021-10-11 | In force | TAP | Unified IoT Identifiers for intelligent transport systems |
| [Y.4810](http://www.itu.int/itu-t/workprog/wp_item.aspx?isn=16412) | 2021-11-29 | In force | AAP | Requirements of data security for the heterogeneous IoT devices |
| [Y.4811](http://www.itu.int/itu-t/workprog/wp_item.aspx?isn=16413) | 2021-11-29 | In force | AAP | Reference framework of converged service for identification and authentication for IoT devices in decentralized environment |
| [Y.4904](http://handle.itu.int/11.1002/1000/13864) | 2019-12-06 | In force | AAP | Smart sustainable cities maturity model |
| [Y.4905](http://handle.itu.int/11.1002/1000/13865) | 2019-02-13 | In force | AAP | Smart sustainable city impact assessment |
| [Y.4906](http://handle.itu.int/11.1002/1000/13922) | 2019-07-07 | In force | AAP | Assessment framework for digital transformation of sectors in smart cities |
| [Y.4907](http://www.itu.int/itu-t/workprog/wp_item.aspx?isn=14949) | 2020-08-29 | In force | AAP | Reference architecture of blockchain-based unified KPI data management for smart sustainable cities |
| [Y.4908](https://www.itu.int/ITU-T/workprog/wp_item.aspx?isn=13679) | 2020-12-16 | In force | TAP | Performance evaluation frameworks of e-health systems in the IoT |

**TABLE 8  
Study Group 20 – Recommendations consented/determined at the last meeting**

|  |  |  |  |
| --- | --- | --- | --- |
| **Recommendation** | **Consent/Determination** | **TAP/AAP** | **Title** |
| None. |  |  |  |

**TABLE 9  
Study Group 20 – Recommendations deleted during study period**

| **Recommendation** | **Last version** | **Withdrawal date** | **Title** |
| --- | --- | --- | --- |
| None |  |  |  |

**TABLE 10  
Study Group 20 – Recommendations submitted to WTSA-20**

| **Recommendation** | **Proposal** | **Title** | **Reference** |
| --- | --- | --- | --- |
| None |  |  |  |

**TABLE 11  
Study Group 20 – Supplements**

| **Supplements** | **Approval** | **Status** | **Title (English)** |
| --- | --- | --- | --- |
| [Y.Suppl.32 ITU-T 4000 series](http://www.itu.int/itu-t/workprog/wp_item.aspx?isn=16686) | 2020-07-16 | In force | Smart sustainable cities - A guide for city leaders |
| [Y.Suppl.33 ITU-T 4000 series](http://www.itu.int/itu-t/workprog/wp_item.aspx?isn=16685) | 2020-07-16 | In force | Smart sustainable cities - Master plan |
| [Y.Suppl.34 ITU-T 4000 series](http://www.itu.int/itu-t/workprog/wp_item.aspx?isn=16687) | 2020-07-16 | In force | Smart sustainable cities - Setting the stage for stakeholders' engagement |
| [Y Suppl. 45](http://handle.itu.int/11.1002/1000/13394) | 2017-09-15 | In force | ITU-T Y.4000-series - An overview of smart cities and communities and the role of information and communication technologies |
| [Y Suppl. 52](http://handle.itu.int/11.1002/1000/13866) | 2018-12-13 | In force | Methodology for building digital capabilities during enterprises' digital transformation |
| [Y Suppl. 53](http://handle.itu.int/11.1002/1000/13867) | 2018-12-13 | In force | ITU-T Y.4000-series – Internet of Things use cases |
| [Y Suppl. 54](http://handle.itu.int/11.1002/1000/13917) | 2019-04-18 | In force | ITU-T Y.4000 series – Framework for home environment profiles and levels of IoT systems |
| [Y Suppl. 56](http://handle.itu.int/11.1002/1000/14174) | 2019-12-06 | In force | ITU-T Y-series – Supplement on use cases of smart cities and communities |
| [Y Suppl. 57](http://handle.itu.int/11.1002/1000/14175) | 2019-12-06 | In force | Implementation guidelines to Recommendation ITU-T Y.4409/Y.2070 |
| [Y.Suppl.58](http://www.itu.int/itu-t/workprog/wp_item.aspx?isn=16426" \o "See more details) | 2019-12-06 | Superseded | Internet of Things and smart cities and communities standards roadmap |
| [Y Suppl. 58](http://handle.itu.int/11.1002/1000/14176) | 2021-05-27 | In force | Internet of things and smart cities and communities standards roadmap |
| [Y.Suppl.61 ITU-T 4400 series](http://www.itu.int/itu-t/workprog/wp_item.aspx?isn=16410) | 2020-07-16 | In force | Features of application programming interface (APIs) for IoT data in smart cities and communities |
| [Y.Suppl.62 ITU-T 4000 series](http://www.itu.int/itu-t/workprog/wp_item.aspx?isn=16404) | 2020-07-16 | In force | Overview of blockchain for supporting Internet of things and smart cities and communities in data processing and management aspects |
| [Y.Suppl.63 ITU-T.4000 series](http://www.itu.int/itu-t/workprog/wp_item.aspx?isn=14103) | 2020-07-16 | In force | Unlocking Internet of things with artificial intelligence |
| [Y.Suppl.68](http://www.itu.int/itu-t/workprog/wp_item.aspx?isn=14647) | 2021-05-27 | In force | Framework for Internet of Things ecosystem Master Plan |
| [Y.Suppl.69](http://www.itu.int/itu-t/workprog/wp_item.aspx?isn=16392) | 2021-05-27 | In force | Web based data model for IoT and smart city systems and services |

**TABLE 12  
Study Group 20 – Technical Papers**

| **Designation** | **Date** | **Title** |
| --- | --- | --- |
| [Y.oneM2M.DG.AppDev](http://www.itu.int/itu-t/workprog/wp_item.aspx?isn=14309) | 2017-09-15 | oneM2M- Application developer guide: Light control example using HTTP binding |
| [Y.oneM2M.DG.CoAP](http://www.itu.int/itu-t/workprog/wp_item.aspx?isn=14310) | 2017-09-15 | oneM2M Developer Guide of CoAP binding and long polling for temperature monitoring |
| [Y.oneM2M.DG.DM](http://www.itu.int/itu-t/workprog/wp_item.aspx?isn=14311) | 2017-09-15 | oneM2M- Developer guide of device management |
| [Y.oneM2M.DG.SEM](http://www.itu.int/itu-t/workprog/wp_item.aspx?isn=14319) | 2017-09-15 | oneM2M-Developer Guide of Implementing semantics |
| [Y.oneM2M.Ind.DE](http://www.itu.int/itu-t/workprog/wp_item.aspx?isn=14325) | 2017-09-15 | oneM2M Industrial Domain Enablement |
| [Y.oneM2M.UCC](http://www.itu.int/itu-t/workprog/wp_item.aspx?isn=14329) | 2017-09-15 | oneM2M Use Case Collection |

TABLE 13  
Study Group 20 – Technical Reports

| Recommendation | Date | Status | Title |
| --- | --- | --- | --- |
| None. |  | New/ Revised/ Deleted |  |

TABLE 14  
Study Group 20 – Other publications

| Recommendation | Date | Status | Title |
| --- | --- | --- | --- |
| None. |  | New/ Revised/ Deleted |  |

# ANNEX 2

Annex A  
(to WTSA Resolution 2)

**Proposed updates to the Study Group 20 mandate and Lead Study Group roles**

The following are the proposed changes to the Study Group 20 mandate and Lead Study Group roles agreed at the last Study Group 20 meeting in this study period, based on the relevant portions of [WTSA-16 Resolution 2](https://www.itu.int/dms_pub/itu-t/opb/res/T-RES-T.2-2016-PDF-E.pdf).

#### PART 1 ‑ General areas of study

**ITU‑T Study Group 20**

**Internet of things (IoT) and smart cities and communities**

Study Group 20 is responsible for studies relating to Internet of things (IoT) and its applications, and smart cities and communities (SC&C). This includes studies relating to big data aspects of IoT and SC&C, digital services for SC&C and digital transformation relevant IoT and SC&C aspects.

**PART 2 – Lead ITU-T study groups in specific areas of study**

SG20 Lead study group on Internet of things (IoT) and its applications

Lead study group on smart cities and communities and related digital services

Lead study group for Internet of things identification

Lead study group on digital health related to IoT and smart cities and communities

Annex B  
(to WTSA Resolution 2)  
  
Points of guidance to ITU-T study groups for development  
of the post-2021 work programme

ITU‑T Study Group 20 will work on the following items:

* framework and roadmaps for the harmonized and coordinated development of Internet of things (IoT), including machine-to-machine (M2M) communications, ubiquitous sensor networks and smart sustainable cities, in ITU-T and in close cooperation with the ITU Radiocommunication Sector (ITU-R) and ITU Telecommunication Development (ITU-D) study groups and other regional and international standards organizations and industry forums;
* requirements and capabilities for IoT and smart cities and communities (SC&C) including verticals;
* definitions and terminology for IoT and SC&C;
* Solutions provided by emerging digital technologies and their technical impact on IoT and SC&C;
* IoT and SC&C network infrastructure, connectivity and devices, and digital services and applications, including architectures, architecture frameworks for IoT and SC&C;
* Evaluation, assessment as well as service analysis and infrastructure for SC&C regarding the use of emerging digital technologies on the smartness of cities;
* guidelines, methodologies and best practices related to standards to help cities, communities, rural areas and villages deliver services using emerging digital technologies;
* identification aspects of IoT and SC&C in collaboration with other study groups as appropriate;
* protocols and interfaces for IoT and SC&C systems, services and applications;
* Platforms for IoT and SC&C;
* interoperability and interworking of IoT and SC&C systems, services and applications;
* quality of service (QoS) and end-to-end performance for IoT and SC&C in collaboration with SG12, as appropriate;
* security, privacy4 and trustworthiness4 of IoT and SC&C systems, services and applications;
* database maintenance of IoT and SC&C standards;
* big data aspects, including big data ecosystems, of IoT and SC&C;
* digital and smart services for SC&C;
* IoT and SC&C data processing and management, including data analytics, and AI-enabled applications;
* Technical aspects of data value chain for IoT and SC&C, in collaboration with SG3 as appropriate;
* data sets and semantics based capabilities for IoT and SC&C including verticals.

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4 Some relevant aspects of this term may be considered differently from one Member State to another. The use of this term is framed in terms of international telecommunication standardization.

Annex C  
(to WTSA Resolution 2)  
  
List of Recommendations under the responsibility of the respective   
study groups and TSAG in the 2022-2024 study period

ITU‑T F.744, ITU‑T F.747.1 – ITU‑T F.747.8, ITU‑T F.748.0 – ITU‑T F.748.5 and ITU‑T F.771

ITU‑T H.621, ITU‑T H.623, ITU‑T H.641, ITU‑T H.642.1, ITU‑T H.642.2 and ITU‑T H.642.3

ITU-T L.1600, ITU-T L.1601, ITU-T L.1602, ITU-T L.1603

ITU‑T Q.3052

ITU‑T Y.4000-series, ITU‑T Y.2016, ITU‑T Y.2026, ITU‑T Y.2060 – ITU‑T Y.2070, ITU‑T Y.2074 – ITU‑T Y.2078, ITU‑T Y.2213, ITU‑T Y.2221, ITU‑T Y.2238, ITU‑T Y.2281 and ITU‑T Y.2291

NOTE – Recommendations transferred from other study groups have double numbers in the Y.4000-series.

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