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| **Abstract:** | This report summarizes progress achieved ITU-T standardization from January to September 2021, as well as measures taken by TSB to enhance the ITU-T standardization platform. |

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**ملخص تنفيذي**

وافق الاتحاد على أكثر من 200 توصية جديدة ومراجَعة لقطاع تقييس الاتصالات بالاتحاد في الفترة الممتدة من يناير إلى سبتمبر 2021. ويورد التذييل I قائمة بتوصيات القطاع والنصوص المتصلة بها ويوجز مضمونها. ويقدم القسم 1 مجموعة مختارة من النصوص التي تمت الموافقة عليها في الفترة المشمولة بالتقرير. ويمكن الاطلاع على الملخصات التنفيذية لاجتماعات لجان دراسات القطاع في [الصفحات الرئيسية](https://www.itu.int/en/ITU-T/studygroups/Pages/default.aspx) للجان الدراسات.

وظل عدد أعضاء قطاع تقييس الاتصالات يتزايد في الفترة من يناير إلى سبتمبر 2021، إذ رحب القطاع بالأعضاء الجدد البالغ عددهم 30 عضواً (سبعة أعضاء قطاع و23 منتسباً)، مما أدى إلى زيادة صافية حالياً قدرها عشرة. وقد انضم 13 كياناً من هذه الكيانات كمنتسبين في سياق هيكل الرسوم المخفضة للشركات الصغيرة والمتوسطة. وبالإضافة إلى ذلك، انضم إلى الاتحاد 13 عضواً جديداً من الهيئات الأكاديمية خلال هذه الفترة.

ولا تزال الاجتماعات الافتراضية وأساليب العمل الإلكترونية المنصة الرئيسية لأعمال التقييس في الاتحاد في إطار التصدي العالمي لجائحة فيروس كورونا (كوفيد-19). ويستخدم أعضاء الاتحاد بصورة مثلى المنصة [[MyWorkspace](https://www.itu.int/net4/ITU-T/myworkspace/)](https://www.itu.int/net4/ITU-T/myworkspace/) الشخصية والخدمات والأدوات المرتبطة بها التي يوفرها مكتب تقييس الاتصالات مثل أداة MyMeetings. وعُقد 19 اجتماعاً نظامياً بنسق إلكتروني في الفترة من يناير إلى سبتمبر 2021. ونُظمت 47 ورشة عمل وندوة خلال الفترة نفسها، بالإضافة إلى البرامج الأسبوعية للمنصة الرقمية [الذكاء الاصطناعي من أجل تحقيق الصالح العام](https://aiforgood.itu.int/) على مدار السنة.

وعُقدت الندوة الثالثة والأخيرة [للمبادرة العالمية للشمول المالي (FIGI)](https://figi.itu.int/) بنسق إلكتروني في الفترة من 18 مايو إلى 24 يونيو 2021، وتناولت مواضيع منها التكنولوجيا المالية من أجل الشمول، والمساواة بين الجنسين، وحماية المستهلك، والأمن السيبراني والثقة، والهوية الرقمية، وقبول المدفوعات، والخبرة المكتسبة في الوصول إلى الفئات السكانية المفتقرة إلى الخدمات والفئات الضعيفة خلال جائحة كوفيد-19. وعرضت ندوات المبادرة العالمية للشمول المالي التجارب الوطنية في مجال تعزيز الشمول المالي كما عرضت أحدث النتائج والتقارير المقدمة من أفرقة العمل المعنية بالمبادرة. اطلع على مزيد من التفاصيل حول الندوة في عدد مخصص من [مجلة أخبار الاتحاد](https://www.itu.int/en/myitu/Publications/2021/09/20/14/33/ITU-News-Magazine--Issue-3-2021).

وتدعم [مذكرة تفاهم](https://www.itu.int/en/ITU-T/extcoop/Pages/mou.aspx) جديدة بين الاتحاد الدولي للاتصالات ومنظمة العلاقات الاقتصادية الدولية تم توقيعها في 8 سبتمبر 2021، التعاون بين الطرفين للمضي قدماً بالتحول الرقمي للمدن والمجتمعات، مما أسهم في العمل الذي تضطلع به [مبادرة "متحدون من أجل المدن الذكية المستدامة"](https://www.itu.int/en/ITU-T/ssc/united/Pages/default.aspx) ولا سيما برنامج التنفيذ الخاص بها الذي يدعم المدن في جميع أنحاء العالم في الاستفادة من تكنولوجيا المعلومات والاتصالات كجزء من استراتيجيات التنمية الحضرية.

وتعرِّف [حلقة دراسية إلكترونية بشأن الذكاء الاصطناعي من أجل تحقيق الصالح العام](https://aiforgood.itu.int/event/ai-for-road-safety/) عقدت في 6 أكتوبر 2021 بمبادرة جديدة بشأن الذكاء الاصطناعي من أجل السلامة على الطرق. وأنشئت هذه المبادرة بشراكة بين الاتحاد الدولي للاتصالات والمبعوث الخاص للأمين العام للأمم المتحدة المعني بالسلامة على الطرق ومبعوث الأمين العام للأمم المتحدة المعني بالتكنولوجيا. وتهدف مبادرة الذكاء الاصطناعي من أجل السلامة على الطرق إلى الاستفادة من الذكاء الاصطناعي في تعزيز نهج النظام الآمن للسلامة على الطرق تماشياً مع قرار الجمعية العامة للأمم المتحدة ([UN A/RES/74/299](https://undocs.org/en/A/RES/74/299)) بشأن تحسين السلامة على الطرق في العالم، الذي يسلط الضوء على دور تكنولوجيا السيارات والتكنولوجيات الرقمية المبتكرة في هذا الصدد.

ومكنت الدورة الأولى من [مسابقة الاتحاد بشأن الذكاء الاصطناعي والتعلم الآلي في شبكات الجيل الخامس](https://www.itu.int/en/ITU-T/AI/challenge/2020/Pages/default.aspx) التي نظمت في عام 2020 أكثر من 1 300 مشارك من 62 بلداً من التنافس لتحقيق الأهداف المحددة في بيانات إشكالية مقدمة من دوائر صناعية وأوساط أكاديمية. ويجري العمل في 2021 على تنظيم [الدورة الثانية من المسابقة](https://aiforgood.itu.int/about/aiml-in-5g-challenge/) التي ستتيح للشركاء والمضيفين والمشاركين فرصة التعاون على بيانات إشكالية ومجموعات بيانات وحلول جديدة. وتشجع المسابقة وتدعم المجتمع المتنامي الذي يقود دمج الذكاء الاصطناعي/التعلم الآلي في الشبكات وتعزز في الوقت نفسه المجتمع الذي يقود أعمال التقييس المتعلقة بالذكاء الاصطناعي/التعلم الآلي.

ونشرت [مجلة الاتحاد بشأن التكنولوجيات المستقبلية والمتطورة](https://www.itu.int/en/journal/j-fet/Pages/default.aspx) عددها العادي الثاني في أبريل 2021، وسيكتمل عددها العادي الثالث قبل نهاية 2021. وستُنشر مجموعة من الأعداد الخاصة في أكتوبر 2021 بشأن موضوع [حلول الذكاء الاصطناعي والتعلم الآلي في شبكات الجيل الخامس وشبكات المستقبل](https://www.itu.int/en/journal/j-fet/2021/005/Pages/default.aspx)، بقيادة المجتمع الداعم لمسابقة الاتحاد بشأن الذكاء الاصطناعي والتعلم الآلي في شبكات الجيل الخامس، وكذلك مواضيع [إنترنت كل شيء](https://www.itu.int/en/journal/j-fet/2021/002/Pages/default.aspx)، و[إنترنت الأشياء الحيوية المتناهية الصغر لأغراض تطبيقات الصحة، والاتصالات بالتيراهرتز](https://www.itu.int/en/journal/j-fet/2021/001/Pages/default.aspx)، و[أنظمة الاتصالات اللاسلكية ما بعد عصر الجيل الخامس](https://www.itu.int/en/journal/j-fet/2021/004/Pages/default.aspx). والورقات المنشورة متاحة للتنزيل مجاناً من [مكتبة الاتحاد الرقمية](https://www.itu.int/pub/S-JNL).

وستُعقد الدورة 13 من [مؤتمر كاليدوسكوب الاتحاد:*توصيل العالم المادي والعالم الافتراضي*](https://www.itu.int/en/ITU-T/academia/kaleidoscope/2021/Pages/default.aspx) إلكترونياً في الفترة من 6 إلى 10 ديسمبر 2021. وسيعرض المؤتمر ورقات أكاديمية أصلية تتضمن رؤى بشأن المشاريع والبحوث الجارية ذات الصلة بتطوير الواقع الافتراضي السائد وإنشاء بيئات مخصصة بواسطة الحاسوب، وكذلك الإمكانيات الجديدة وما يرتبط بها من تحديات تتجلى في الأفق.

ونُشر أكثر من 5 000 صفحة من توصيات قطاع تقييس الاتصالات وإضافاتها في الفترة ما بين يناير وسبتمبر 2120. ولا تزال جميع النسخ الرئيسية من توصيات القطاع تحوَّل إلى نسق ePub القابل للتكييف، وتُنشر لتنزيلها مجاناً إلى جانب النسق PDF الاعتيادي. ولا يزال منتج الاتحاد الصادر باسم "توصيات وكتيبات مختارة صادرة عن قطاع تقييس الاتصالات" يُنشر على أساس ربع سنوي في مفتاح USB.

ويواصل مكتب تقييس الاتصالات جمع كل المصطلحات والتعاريف الجديدة التي تقترحها لجان دراسات قطاع تقييس الاتصالات، ويدرجها في قاعدة بيانات مصطلحات وتعاريف الاتحاد. وترجم المكتب ثماني توصيات جرت الموافقة عليها في إطار عملية الموافقة البديلة (AAP) في عام 2021، وذلك وفقاً للطلبات الواردة من لجان الدراسات التابعة للقطاع والمجموعات اللغوية، وفي حدود الميزانية المتاحة.

# Annex – Full Report of activities in ITU-T (from January to September 2021)

# 1 Selection of achievements in ITU-T standardization

Executive summaries for the various ITU-T SG meetings can be found on the homepages of [ITU-T SGs](https://www.itu.int/en/ITU-T/studygroups/Pages/default.aspx).

ITU approved more than [200](https://www.itu.int/itu-t/workprog/wp_search.aspx?isn_sp=3925&isn_status=-1,2&adf=2021-01-01&adt=2021-09-30&details=0&field=acdefghijo) new and revised ITU-T Recommendations from January to September 2021. Appendix I lists these ITU-T Recommendations and related texts and summarizes their contents.

**IMT-2020/5G transport:** New standards describe the functional architecture of the metro transport network (G.8310) and a transport technology for the metro transport network (G.8312), including transport of distributed radio access network traffic and centralized radio access network traffic.

**IMT-2020/5G networking and security:** New standards address IMT-2020 network slice configuration (Y.3157), service scheduling for supporting fixed-mobile convergence in IMT-2020 (Y.3135), internetworking of heterogeneous application domain connected objects through information-centric networking in IMT-2020 (Y.3077), and provide security guidelines for applying quantum-safe algorithms in IMT-2020 (X.1811).

**Machine learning for IMT-2020/5G:** New standards provide architectural frameworks for AI-based network automation (Y.3177) and machine learning model serving (Y.3179), and a functional framework of AI-based network service provisioning (Y.3178).

**Machine learning for quantum key distribution networks:** A new supplement presents the applications of machine learning in the quantum layer, the key management layer and the management and control layers of quantum key distribution networks, including the use case background and analysis (Y Suppl.70).

**Intelligent transport systems:** New standards provide a functional architecture of network-based driving assistance for autonomous vehicles (Y.4471), a security-related misbehaviour detection mechanism using big data for connected vehicles (X.1376), and use cases for multimedia communication enabled vehicle systems using AI (F.749.4).

**Security:** New and revised standards address the governance of information security (revised X.1054) and provide a framework for the creation and operation of a cyber defence centre (X.1060), guidelines for applying threat intelligence in telecommunication network operation (X.1217), baseline identity management terms and definitions (revised X.1252), and guidelines for countering spam over instant messaging (X.1233).

**Internet of Things:** New standards provide the requirements and capability framework of edge computing-enabled gateway in IoT (Y.4122), the requirements and capability framework of smart utility metering (Y.4419), a framework of IoT-based monitoring and management for lifts (Y.4420), and a secure firmware/software update for IoT devices (X.1368).

**Distributed ledger technologies:** New standards define security threats and requirements for digital payment services based on distributed ledger technology (X.1405) and security threats to online voting systems using distributed ledger technology (X.1406), and provide an object identifier based resolution framework for transaction of distributed ledger assigned to IoT resources (Y.4476).

**Electromagnetic fields:** The supplement providing a guide on electromagnetic fields and health was revised to include updated information on WHO and ICNIRP guidelines and relevant aspects of 5G (K Suppl.1). The associated [EMF Guide web and mobile app](http://emfguide.itu.int/) provides up-to-date information and education resources on electromagnetic fields suitable for all communities and government stakeholders. It is available in the six official languages of the Union.

**Environment and circular economy:** New standards provide a methodology to assess the environmental impact and e-waste generation of different network architectures (L.1050), a guide for the institutions of higher learning to contribute to the effective lifecycle management of e‑equipment and e-waste (L.1033), general principles for green supply chain management in the ICT manufacturing industry (L.1060), and guidance and criteria for ICT organisations on setting Net Zero targets and strategies (L.1471).

**Energy efficiency:** New standards provide guidelines on energy-efficient blockchain systems (L.1317), and smart energy solutions for application in cities and homes (L.1383).

**Performance of terminals and multimedia subjective assessment:** New and revised standards discuss technical requirements and test methods for the digital wired or wireless headset interface of mobile terminals (P.383), artificial ears (revised P.57), and head and torso simulator for telephonometry (revised P.58). Revised standards also provide guidance on the calculation of loudness for speech communication (revised P.700) and the subjective evaluation of speech quality with a crowdsourcing approach (revised P.808).

**Quality assessment of video communications and applications:** Revised standards describe methods for the subjective assessment of video quality, audio quality and audiovisual quality of Internet video and distribution-quality television in any environment (revised P.913), and parametric bitstream-based quality assessment of progressive download and adaptive audiovisual streaming services over reliable transport - quality integration module (revised P.1203.3).

**Combating counterfeit and ICT device theft:** A new standard addresses the methodologies and interfaces between mobile device access list audit systems and mobile network operators' equipment identity registers (Q.5053). New supplements define guidelines for permissive versus restrictive system implementations to address counterfeit, stolen and illegal mobile devices (Q Suppl.73) and provide a roadmap for the combatting of counterfeit ICT and stolen mobile devices (Q Suppl.74).

**Data handling and cloud computing:** New standards provide functional architecture for big data driven networking (Y.3653) and an end-to-end fault and performance management framework of network services in inter-cloud (Y.3527).

**Protocols:** New standards provide signalling requirements for virtualized network function lifecycle management in a testing environment (Q.4067), and protocols for managing intelligent network slicing with AI-assisted analysis in IMT-2020 network (Q.5023) and hybrid peer-to-peer communications: tree and data recovery procedures (Q.4101).

**Test specifications:** New standards provide a framework of a model network for tactile Internet testing (Q.4065), a test suite for the interoperability testing of virtual switches (Q.4044), and open application programming interfaces for interoperable testbed federations (Q.4068).

# 2 ITU-T Focus Groups

## 2.1 Active groups

[AI for Natural Disaster Management (FG-AI4NDM)](https://www.itu.int/en/ITU-T/focusgroups/ai4ndm/Pages/default.aspx)

* 1st meeting and workshop: 15-17 March 2021
* 2nd meeting and workshop: 23-25 June 2021
* 3rd meeting and workshop: 30 August - 2 September 2021
* 4th meeting: 20 October 2021

[AI for Health (FG-AI4H)](https://www.itu.int/en/ITU-T/focusgroups/ai4h)

* 11th meeting: 27-29 January 2021
* 12th meeting: 19-21 May 2021
* 13th meeting: 28-30 September 2021

[Autonomous Networks (FG-AN)](https://www.itu.int/en/ITU-T/focusgroups/an/Pages/default.aspx)

* 1st meeting: 2-4 February 2021
* 2nd meeting: 13-16 April 2021
* 3rd meeting: 15-17 June 2021
* 4th meeting: 1-3 September 2021
* 5th meeting: 3-5 November 2021

[AI for Autonomous and Assisted Driving (FG-AI4AD)](https://www.itu.int/en/ITU-T/focusgroups/ai4ad)

* 5th meeting: 2-3 March 2021
* 6th meeting: 2-3 June 2021
* 7th meeting: 6-7 October 2021
* 8th meeting: 1-2 December 2021 (planned)

[Environmental Efficiency for AI and other Emerging Technologies (FG-AI4EE)](https://www.itu.int/en/ITU-T/focusgroups/ai4ee/Pages/default.aspx)

* 3rd meeting: 7-8 April 2021.
* 4th meeting: 20-21 October 2021

[Quantum Information Technology for Networks (FG-QIT4N)](https://www.itu.int/en/ITU-T/focusgroups/qit4n/Pages/default.aspx)

* 6th meeting: 26 October - 6 November 2020
* 7th meeting: 25 January - 5 February 2021
* 8th meeting: 10-21 May 2021
* 9th meeting: 9-20 August 2021
* **10th meeting:** 15-22 November 2021

[Vehicular Multimedia (FG-VM](https://www.itu.int/en/ITU-T/focusgroups/vm/Pages/default.aspx))

* 12th meeting: 12-13 April 2021
* 13th meeting: 29 June 2021
* 14th meeting: 29 September 2021
* 15th meeting: 6-7 October 2021

# 3 Cooperation and coordination

TSB implements ITU-T Objective T.5 of the Strategic Plan of the Union, "Extend and facilitate cooperation with international, regional and national standardization bodies".

Memoranda of Understanding and Cooperation Agreements are listed and available on the relevant [web page](https://www.itu.int/en/ITU-T/extcoop/Pages/mou.aspx).

## 3.1 World Standards Cooperation

IEC, ISO, and ITU cooperate under the banner of the [World Standards Cooperation](https://www.worldstandardscooperation.org/).

Around 10% of ITU's standards are common or aligned texts with [ISO/IEC Joint Technical Committee 1 (Information Technology)](https://jtc1info.org/). Work of common interest benefits from the [ITU-ISO-IEC Standardization Programme Coordination Group](https://www.itu.int/en/ITU-T/extcoop/Documents/tor/ToR_SPCG.pdf) and the new [ITU-ISO-IEC Joint Task Force on Smart Cities](https://www.itu.int/en/myitu/News/2020/10/08/13/10/New-smart-city-standards-Joint-Task-Force-established-by-ITU-ISO-and-IEC).

The IEC-ISO-ITU Joint Smart Cities Task Force (J-SCTF) organized on 21 June 2021 a [Forum on "Strengthening IEC, ISO and ITU collaboration for Smart Cities"](https://www.itu.int/en/ITU-T/Workshops-and-Seminars/2021/0621).

[World Standards Day](https://www.worldstandardsday.org/home.html)**:** IEC, ISO and ITU lead the celebration of World Standards Day, 14 October. "A Shared Vision for a Better World" is the theme of this year's World Standards Day, which marks the start of a multi-year campaign aimed at raising awareness of how international standards contribute to the United Nations Sustainable Development Goals.

## 3.2 National and regional standardization organizations

TSB facilitates an ITU-T presence in activities arranged by other standards bodies, with a view to promoting other standards bodies' engagement with ITU-T workings groups, workshops and related ITU-T collaboration initiatives.

TSB’s efforts in this regard have strengthened the exchange of information between ITU-T and national and regional standards, supporting closer cooperation and collaboration.

Standardization bodies with which TSB is currently expanding cooperation include the African Regional Organization for Standardisation (ARSO),thePan American Standards Commission (COPANT), the Pacific Area Standards Congress (PASC), the South Asian Regional Standards Organization (SARSO), and the Cooperation Council for the Arab States of the Gulf (GCC) Standardization Organization (GSO).

ARSO and GSO became ITU-T members in January 2021.

A brief overview of the engagements in 2021 can be found below.

**CEN-CENELEC:** TSB participated in the Common Meeting of the CEN General Assembly and CENELEC General Assembly, 24 June 2021.

**ETSI:** The TSB Director participated in the 77th ETSI General Assembly, 13-14 April 2021.

**PASC:** The TSB Director participated in the 43rd PASC AGM in a session dedicated to IEC, ISO and ITU on 18 May 2021 where the discussions focused on New Normal for Standards Development, Sustainability in Standards Development and Inclusivity in Standards Development. The AGM was hosted by the National Standardization Agency of Indonesia (BSN), which provided the secretariat for PASC in 2021.

**COPANT:** TSB participated in two panels organized in the context of the COPANT Week 2021:

* SDGs, standards and technical regulations: IEC/ISO/ITU panel on how international standards can support in the achievement of the SDGs.
* Best practices of standards bodies (international, regional and national) in response to the COVID-19 pandemic - lessons learned and new practices to maintain: IEC/ISO/ITU panel on the role of international organizations in response to the pandemic, recommendations, practices to be maintained, etc.
* In addition, an overview of ITU-T activities was provided to COPANT and shared with all members, associates and invited guests at the General Assembly.

## 3.3 Regional Organizations and ITU Regional and Area Offices

An overview of all WTSA regional preparatory meetings can be found on the [WTSA-20 web page](https://www.itu.int/en/ITU-T/wtsa20/prepmeet/Pages/default.aspx). The page is continuously updated and lists all relevant events.

At the initiative of the TSB Director, TSB has been organizing conference calls and face-to-face meetings on a regular basis with ITU’s Regional and Area Offices. The activity supports the coordination and efficiency of the activities, operations and events of ITU-T and TSB and also contributes to greater awareness of ITU-T standardization activities in all Regions.

In the reporting period, TSB participated in the following meetings, in coordination with the ITU Regional and Area Offices:

**Africa:**

* + - * ATU-4 meeting, 27 September - 1 October 2021

**Americas:**

* Working Group for the preparation and follow-up of WTSA, WCIT and WTDC, 22 January 2021
* 38th meeting of PCC.I, 28-30 April 2021
* 39th meeting of PCC.I, 4-8 October 2021

**Arab States:**

* 16th ASTeam meeting, 2 September 2021

**Asia and the Pacific:**

* APT WTSA20-e, Extraordinary meeting of APT Preparatory Meeting for WTSA-20, 17-19 November 2021
* 33rd APT Standardization Program Forum (ASTAP-33), 7-11 June 2021

**CIS:**

* RCC Commission on International cooperation coordination / Working Group on ITU of the RCC Commission on International cooperation coordination, 17 February 2021
* 40th/31st Joint Meeting of the RCC Commission on the Coordination of International Cooperation and the RCC Working Group on Work with ITU, 27 August 2021.

**Europe:**

* Com-ITU meeting, 20-22 January 2021
* PT ITU-T meeting, 1-3 March 2021
* PT ITU-T meeting, 5-7 May 2021
* Com-ITU Meeting, 21-23 June 2021
* PT ITU-T meeting, 15 September 2021
* Com-ITU meeting, 13-15 September
* PT ITU-T meeting, 5 October 2021

## 3.4 ITU Sectors

TSAG maintains a close relationship with RAG and TDAG in order to develop synergies with the objective of strengthening coordination and cooperation among the three ITU Sectors on matters of mutual interest.

Three Inter-Sector Rapporteur groups (IRGs) work on items of interest to various ITU-T and ITU-R SGs.

* [IRG-AVA](https://www.itu.int/en/irg/ava): Intersector Rapporteur Group on Audiovisual Media Accessibility, among ITU-T SG9, ITU-T SG16 and ITU-R SG6. Meeting were held on 9 April 2021 and 23 September 2021.
* [IRG-AVQA](https://www.itu.int/en/irg/avqa): Intersector Rapporteur Group on Audiovisual Quality Assessment, among ITU-T SG12 and ITU-R SG6. A meeting was held on 9 June 2021, in conjunction with the Video Quality Expert Group (VQEG).
* [IRG-IBB](https://www.itu.int/en/irg/ibb): Intersector Rapporteur Group on Integrated Broadcast-Broadband, among ITU-T SG9, ITU-T SG16 and ITU-R WP 6B.

The Inter-Sector Coordination Team (ISCT) is composed of representatives of all three advisory groups, working to identify subjects of common interest to the three Sectors. It also seeks to identify the mechanisms necessary to strengthen cooperation and joint activities among the three Sectors, with particular emphasis on the interests of developing countries. In addition, the ITU Inter-Sectoral Coordination Task Force (ISC-TF) is coordinating activities among the three Bureaux. Both ISCT and of ISC-TF regularly report their progress to TSAG.

# 4 Collaboration initiatives

## 4.1 Artificial intelligence and machine learning

**AI and machine learning in IMT-2020/5G:** The [ITU Challenge on AI and machine learning in 5G](https://aiforgood.itu.int/about/aiml-in-5g-challenge/) enabled over 1300 participants from 62 countries to connect with new partners in industry and academia — and new tools and data resources — to achieve goals set out by problem statements contributed by industry and academia. The second edition of the Challenge is underway in 2021, providing an opportunity for partners, hosts and participants to collaborate on new problem statements, datasets and solutions. Through the Challenge, ITU encourages and supports the growing community driving the integration of AI/ML in networks (through problem statements, webinars, roundtables, etc) and at the same time enhances the community driving standardization work for AI/ML. The 2021 edition of the Challenge is sponsored by Xilinx.

To share the solutions with the larger community, solutions submitted in 2020 are shared as open source in several repositories on the Challenge GitHub: <https://github.com/ITU-AI-ML-in-5G-Challenge>. Furthermore, the [ITU Journal on Future and Evolving Technologies](https://www.itu.int/en/journal/j-fet/Pages/default.aspx) issued a call for papers for a special issue on AI and machine learning solutions in 5G and future networks. In this special issue to be published in October 2021, the Challenge hosts (i.e., the originators of the problem statements) and participants submitted their solutions and learnings for publication. After rigorous review by reviewers in conjunction with guest editors, 10 papers were accepted for publication.

**AI for Good:** [AI for Good](https://aiforgood.itu.int/) is now presented as a year-round digital platform where AI innovators and problem owners learn, build and connect to help identify practical AI solutions to advance the United Nations Sustainable Development Goals. AI for Good is supported by close to 40 UN partners as well as a range of industry sponsors. AI for Good features weekly [programming](https://aiforgood.itu.int/programme/) with the following programming streams:

Learn:

* AI for Good Keynotes
* AI for Good Webinars
* AI for Good Discovery (trustworthiness, health, climate science)
* AI for Good Perspectives
* AI for Good On the Go!
* AI for Good Blog

Build:

* AI for Good Machine Learning 5G Challenge
* AI for Good Innovation Factory
* AI for Good related (Pre-)Standardization Efforts & Initiatives
AI for Good Breakthroughs
* AI for Good Gateway

Connect:

* AI for Good Global Summit
* AI for Good Artistic Intelligence
* UN AI Actions
* AI for Good Brain Trust
* AI for Good Neural Network (coming soon)

**AI for Road Safety:** ITU, the UN Secretary-General’s Special Envoy for Road Safety and the UN Secretary-General's Envoy on Technology agreed to launch a new initiative on AI for Road Safety (see [TSB Circular 340).](https://www.itu.int/md/T17-TSB-CIR-0340/en) The AI for Road Safety initiative is in line with the UN General Assembly Resolution ([UN A/RES/74/299](https://undocs.org/en/A/RES/74/299)) on improving global road safety, which highlights the role of innovative automotive and digital technologies in this regard.

This initiative aims to leverage AI in enhancing the safe system approach to road safety. It will also support the achievement of SDG target 3.6 to halve the annual number of global deaths and injuries from road traffic accidents by 2030, and SDG target 11.2 to provide access to safe, affordable, accessible and sustainable transport systems for all by 2030.

The initiative will be launched during an [AI for Good webinar](https://aiforgood.itu.int/event/ai-for-road-safety/) on 6 October 2021. Activities in support of the initiative will include leveraging the ITU‑T Focus Group on AI for Autonomous and Assisted Driving.

## 4.2 Digital financial inclusion

The[Financial Inclusion Global Initiative (FIGI)](https://figi.itu.int) is a three-year programme of collective action led by ITU, the World Bank Group and the Committee on Payments and Market Infrastructures, with support from the Bill & Melinda Gates Foundation. FIGI is designed to advance research in digital finance and accelerate digital financial inclusion in developing countries. ITU leads the FIGI Security, Infrastructure and Trust Working Group as well as the organization of FIGI symposia.

The third and final FIGI Symposium was held online over six weeks from 18 May to 24 June 2021. H.M. Queen Maxima of The Netherlands, the UN Secretary General’s Special Advocate for Inclusive Finance and Development, made a keynote address at the opening of the event. The recordings of the sessions of the Symposium can be accessed online [here](https://figi.itu.int/programme/). The event saw participation of some 1,782 live participants from 148 countries over the six-week period and the recordings were accessed by some 5,870 people worldwide.

FIGI has worked to raise awareness about SS7’s security vulnerabilities and associated mitigation techniques. As the need to mitigate these vulnerabilities increases, network operators can look to ITU’s new Q.3057 standard outlining signalling requirements and architecture for interconnection between trustable network entities.

Under ITU-led work in the FIGI Security, Infrastructure and Trust working group, the following activities were undertaken in 2021:

* The methodology for QoS/QoE measurement for interoperability and cross border payment report will be further discussed in ITU-T Study Group 12 in 2021 to be integrated in a new ITU-T Recommendation.
* A new Question (Q13) was created in Study Group 12 on perceptual and field assessment principles for quality of service (QoS) and quality of experience (QoE) of digital financial services (DFS) – all DFS QoS recommendations including the interoperability and cross-border QoS testing will be standardized in this Question.
* ITU set up a DFS Security Lab under FIGI work to conduct security audit of DFS mobile applications used in developing and Least Developed countries. The security lab has conducted security audit of mobile payment applications used in Zambia and is working with developing economies in Africa and Asia to implement the security recommendations from FIGI and conduct security audit of mobile payment applications used in those countries.
* The following reports were published in 2021:
	+ [eKYC use cases in DFS](https://figi.itu.int/wp-content/uploads/2021/05/e-KYC-innovations-use-cases-in-digital-financial-services.pdf);
	+ [DFS Competency Framework](https://www.itu.int/en/ITU-T/extcoop/figisymposium/Documents/20-00382_Consumer%20Competency%20Framework.pdf);
	+ [DFS Security audit guideline](https://figi.itu.int/wp-content/uploads/2021/05/Digital-Financial-Services-security-audit-guideline.pdf);
	+ [Security audit of Android based DFS applications](https://figi.itu.int/wp-content/uploads/2021/05/Security-audit-of-various-DFS-applications.pdf) which describes a methodology for analysis security of Android DFS apps based on OWASP Mobile Top 10 Security Risks.

The new [Digital Currency Global Initiative](https://www.itu.int/en/ITU-T/extcoop/dcgi/Pages/default.aspx) is a collaboration between ITU and Stanford University that was established in July 2020. The Initiative is an open platform for dialogue and research on pilot implementations of digital currency, their use cases, applications and developing specifications for technical standards that will foster adoption, universal access, and ultimately financial inclusion. Its various working groups and work streams held some 11 virtual meetings in the reporting period.

## 4.3 Smart cities and communities

The [United for Smart Sustainable Cities (U4SSC)](http://www.itu.int/en/ITU-T/ssc/united/Pages/default.aspx) initiative is supported by 17 UN bodies with the aim of achieving SDG11: ‘Make cities and human settlements inclusive, safe, resilient and sustainable’.

Cities worldwide are evaluating their progress towards smart city objectives and the SDGs using [U4SSC Key Performance Indicators for Smart Sustainable Cities](https://www.itu.int/en/ITU-T/ssc/united/Pages/publication-U4SSC-KPIs.aspx) based on ITU standards. The results of the KPI evaluations are shared by [city snapshots, factsheets, verification reports](https://www.itu.int/en/ITU-T/ssc/united/Pages/publication-U4SSC-KPIs.aspx) and case studies.

The first U4SSC Country Hub will be hosted by the Austrian Economics Center in Vienna, Austria. The main objective of this country hub is to promote the work of U4SSC.

The leadership of ITU and the Organization for International Economics Relations welcomed a new [Memorandum of Understanding (MoU)](https://www.itu.int/en/ITU-T/extcoop/Pages/mou.aspx) on 8 September 2021. This MoU aims to advance the work related to the digital transformation of cities and communities, contributing to the work of U4SSC and its Implementation Programme in particular.

The [U4SSC Implementation Programme](https://www.itu.int/en/ITU-T/ssc/united/Pages/U4SSC-IP.aspx) is supporting cities’ pursuit of the SDGs by working together with national administrations and city leaders to building a comprehensive approach to smart city development, looking at both KPI evaluations and wider national contexts for planning and action.

U4SSC is developing expert guidance on topics including:

* ICT-based smart city platforms support the digital transformation of public services and their integrated management.
* Cities’ resilience in the face of emergencies such as COVID-19 and routes to economic and financial recovery.
* Public procurement in the digital age to support city leaders in establishing effective processes for the procurement of ICT solutions for smart cities.
* Tools and mechanisms to finance smart city projects, benefiting from the contributions of a wide variety of smart city stakeholders in the public and private sectors.
* The potential for frontier technologies to contribute to smart city innovation, looking at smart-city use cases of technologies in fields such as AI and blockchain.

A new [U4SSC deliverable on "Simple ways to be smart"](https://www.itu.int/en/publications/Documents/tsb/2021-U4SSC-Simple-ways-to-be-smart/index.html) was published in March 2021. It identifies smart interventions that do not require excessive material or capacity inputs, and yet can help cities and settlements to become more inclusive, safe, resilient, and sustainable.

## 4.4 Collaboration on ITS Communication Standards

The intent of the Collaboration is to provide a globally recognized forum for the coordination of an internationally accepted, globally harmonized set of Intelligent Transportation Systems (ITS) communication standards of the highest quality in the most expeditious manner possible to enable the rapid deployment of fully interoperable ITS communication-related products and services in the global marketplace.

The Collaboration meetings, which are typically held twice a year (March and September), are organized back-to-back with other ITS events, e.g., [Symposia on the Future Networked Car](https://www.itu.int/en/fnc/Pages/default.aspx), are opportunities to also exchange information and keep experts updated on ITS standardization. The representatives of involved SDOs are invited to submit to the Collaboration meetings status reports on ITS standardization ongoing in their respective organizations. The CITS maintains the global [ITS Communication Standards DB](https://www.itu.int/net4/ITU-T/landscape#?topic=0.131&workgroup=1&searchValue=&page=1&sort=Revelance).

# 5 Academia

## 5.1 ITU Journal

The [ITU Journal on Future and Evolving Technologies](https://www.itu.int/en/journal/j-fet/Pages/default.aspx) (ITU J-FET), launched in September 2020, published its first complete regular issue in three months, its second regular issue in April 2021, and its third regular issue will be complete by the end of this year. A series of special issues will be published in October 2021 on the topics of [AI and machine learning solutions in 5G and future networks](https://www.itu.int/en/journal/j-fet/2021/005/Pages/default.aspx), [Internet of Everything](https://www.itu.int/en/journal/j-fet/2021/002/Pages/default.aspx), [Internet of Bio-NanoThings for health applications,](https://www.itu.int/en/journal/j-fet/2021/001/Pages/default.aspx) [Terahertz communications](https://www.itu.int/en/journal/j-fet/2021/003/Pages/default.aspx), and [Wireless communication systems in beyond 5G era](https://www.itu.int/en/journal/j-fet/2021/004/Pages/default.aspx). Published papers are available to download free of charge from the [ITU Digital library](https://www.itu.int/pub/S-JNL).

ITU J-FET is currently welcoming submissions to three new special issues that will be published in 2022 on [Towards vehicular networks in the 6G era](https://www.itu.int/en/journal/j-fet/2022/001/Pages/default.aspx), [Integrated and autonomous network management and control for 6G time-critical applications](https://www.itu.int/en/journal/j-fet/2022/002/Pages/default.aspx), and [Innovative network solutions for future services](https://www.itu.int/en/journal/j-fet/2022/003/Pages/default.aspx). Additional special issues are under preparation.

Free, fast and for all, ITU J-FET addresses fundamental and applied research sharing new techniques, concepts, analyses, and tutorials while discussing implications of the latest research on policy, regulations, legal frameworks and the economy and society. It welcomes submissions at any time, on any topic within its scope and publishes papers continuously throughout the year.

In line with the co-publishing agreement signed by ITU and Tsinghua University Press Ltd. in 2019, the joint ITU-Tsinghua University Press journal on [Intelligent and Converged Networks](http://icn.tsinghuajournals.com/) has this year published papers on Networks, Optical Communication, and Wireless Communication, a special issue for WOCC 2020, and a series on Data Driven Intelligence, Sustainability, and Systems. All published papers are available on the [IEEE *Xplore* Digital Library](https://ieeexplore.ieee.org/xpl/RecentIssue.jsp?punumber=9195266). Two new special issues have been launched on [Distributed Next Generation 5G Data Networks](http://icn.tsinghuajournals.com/EN/column/item1661.shtml) and [Reconfigurable Intelligent Surface Aided Wireless Communications](http://icn.tsinghuajournals.com/EN/column/item1662.shtml).

## 5.2 ITU Kaleidoscope academic conferences

The ITU Kaleidoscope series of peer-reviewed academic conferences – technically co-sponsored by the IEEE and the IEEE Communications Society (IEEE ComSoc) – calls for original research on topics of growing strategic relevance to ITU-T.

The 13th edition of the conference will be on the theme of [Connecting physical and virtual worlds](https://www.itu.int/en/ITU-T/academia/kaleidoscope/2021/Pages/default.aspx) and will be held completely online from 6 to 10 December 2021. Original academic papers presented at the conference will share insight into ongoing projects and research relevant to the development of persistent virtual realities and customized computer-generated environments, as well as new possibilities and associated challenges appearing on the horizon.

This 2021 edition includes a [demonstration track](https://www.itu.int/en/ITU-T/academia/kaleidoscope/2021/Pages/demos.aspx) for video demonstrations relevant to the development of persistent virtual realities, customized computer-generated environments and immersive experiences. Inviting contributions until 29 October 2021, this track is intended to offer students, academics and researchers a means to share their research and ongoing projects to a wider international audience, using on-line tools. The demonstrations are expected to focus on applied research related to the topics of K-2021.

# 6 Membership

ITU-T membership has maintained growth between January – September 2021, admitting 30 new members (7 Sector Members and 23 Associates), resulting in a current net increase of 10. 13 of these entities have joined as Associates under the reduced fee structure for SMEs. In addition, 13 new Academia members joined ITU during this period.

## 6.1 Evolution of ITU-T membership

**New Sector Members in 2021:**

QRCrypto SA; New H3C Technologies Co., Ltd.; Zenaciti; Southern African Development Community (SADC); Organisation Internationale de la Francophonie – OIF; Inspur Tianyuan Communication Information System Co. Ltd.; Hewlett Packard Enterprise.

**New Associates in 2021:**

BJT PARTNERS SAS (SG2); Airnity (SG2); iBasis Netherlands B.V. (SG2); Narayana OÜ (SG2); Eseye Ltd (SG2); Vast New Telecom SA (SG2); HMD Global Oy (SG2); Monty UK Global Limited (SG2); Svyazcom LLC (SG11); Net Vision Consultants Inc. (SG11); Sevana OU (SG12); Keysight Technologies, Inc. (SG12); Enablers DMCC (SG12); Mozark Pte Ltd. (SG12); Semtech EMEA Limited (SG15); TQ Delta (SG15); Hisense Broadband Multimedia Technologies Co., Ltd. (SG15); Shenzhen SmartMore Technology Co., Ltd. (SG16); Dust Mobile (SG17); Insikt Intelligence (SG17); Companhia de Telecomunicações de Macau S.A.R.L. (SG20); Augmentcity AS (SG20); Citibeats (SG20).

**New Academia in 2021:**

Center for Technical and Higher Education (CETYS University); Shanghai Advanced Research Institute; University of the West of Scotland; Centro México Digital; EU Business School; Kadir Has University; United Arab Emirates University; University of Thessaly; Shenzhen University; University of Hawaii; State Grid Jiangsu Electric Power Research Institute; State Grid Zhejiang Electric Power Co.,Ltd. Research Institute; Konrad-Adenauer-Stiftung.

**Total ITU-T Sector Members, Associates and Academia (31 December 2009 – 30 September 2021):**

The following table and figure illustrate the evolution of ITU-T membership from 31 December 2009 to 30 September 2021 (noting that the Academia membership category opened in 2011).

**Table 1: Evolution of ITU-T membership from 31 December 2009 to 30 September 2021**

|  | **2009** | **2010** | **2011** | **2012** | **2013** | **2014** | **2015** | **2016** | **2017** | **2018** | **2019** | **2020** | **2021** |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Sector Members | 290 | 261 | 263 | 267 | 274 | 272 | 266 | 253 | 257 | 257 | 268 | 272 | 268 |
| Associates | 101 | 111 | 119 | 128 | 130 | 132 | 132 | 128 | 137 | 157 | 184 | 197 | 211 |
| Academia | ‑ | ‑ | 23 | 40 | 58 | 73 | 95 | 107 | 124 | 153 | 159 | 163 | 160 |
| TOTAL | 391 | 372 | 405 | 435 | 462 | 477 | 493 | 488 | 518 | 567 | 611 | 632 | 639 |

NOTE – Some of the figures in the table above have been subject to retroactive changes

**Figure 1 – Evolution of ITU-T membership from 31 December 2009 to 30 September 2021**

NOTE – The Academia category was created in 2011.

## 6.2 Reduced Associate fee structure for SMEs

In response to the joint invitation sent by BDT and TSB to invite interested ITU Member States to nominate a candidate Knowledge and Implementation Partner (KIP), The Smart Incubator programme has officially launched this summer. Welcoming new start-ups as well as returning ones, looking to improve their skills; see list below. In that regard, the Smart Incubator secretariat held an Advanced Information Management and Security System (AIMS) training recently (2-6 August 2021) to help with the skills needed for each start up to fulfil what they entered the Smart Incubator programme for. This summer, WIPO as a partner has also kindly hosted an information session regarding Intellectual Property (IP) training (22 June 2021). The Smart Incubator secretariat is now focusing on each start-up’s specific need, and how to best help them achieve their goals.

|  |
| --- |
| **Start-up/SMEs** |
| Magic View - Netherlands | Winner of Accessible Europe 2021- BDT Competition |
| DocRep - Rwanda | Winner of the 2018 Telecom Award |
| Casual Payroll - Rwanda | Winner of the 2018 Telecom Award |
| Higaneza Ltd - Rwanda | New incoming start-up |

13 entities have joined as Associates under the reduced fee structure for SMEs during this period:

| **Organization** | **Study Group** | **Area of Interest** |
| --- | --- | --- |
| BJT PARTNERS SAS | SG2 | International numbering resources |
| Airnity | SG2 | International numbering resources |
| Narayana OÜ | SG2 | International numbering resources |
| Svyazcom LLC | SG11 | Combating counterfeit and stolen telecommunication/ICT devices |
| Net Vision Consultants Inc. | SG11 | Network analysis and related systems |
| Sevana OU | SG12 | Call quality monitoring, VoIP Call, audio, voice quality testing |
| Enablers DMCC | SG12 | Perceptual-based objective methods for voice quality measurements & virtualized deployment of recommended methods for network performance, QoS and QoE assessment and frameworks for diagnostic functions  |
| Mozark Pte Ltd. | SG12 | Network experience measurement |
| Dust Mobile | SG17 | Secure mobile communications |
| Insikt Intelligence | SG17 | General interest in Study Group activities |
| TQ Delta  | SG15 | DSL related activities |
| Augmentcity AS | SG20 | Study Group work activities related to U4SSC Implementation Programme and FG-AI4EE |
| Citibeats | SG20 | Study Group activities related to KPIs for Smart Cities |

# 7 Virtual meetings

2021 has again highlighted the value of ITU-T’s electronic working environment. Virtual meetings and electronic working methods have come to form the principal platform for ITU standardization work as part of the global response to COVID-19. ITU members engaged in standards development and preparations for the ITU World Telecommunication Standardization Assembly (WTSA) are making optimal use of the personalized [MyWorkspace](https://www.itu.int/net4/ITU-T/myworkspace/) platform and associated TSB services and tools such as MyMeetings.

MyMeetings is the main platform for ITU-T statutory meetings. MyMeetings is also used to host Rapporteur Group Meetings and non-statutory events, such as webinars. MyMeetings features important elements found in ITU-T physical meetings, including participants’ list and affiliation, multilingual support, moderated floor request and captioning. Several layers of access control ensure that only registered participants gain access to statutory meetings.

Other electronic meeting tools, such as Zoom, are also provided by TSB for hosting fully online (virtual) and any on-demand ad-hoc meetings.

Statistics on e-meetings for the 2019, 2020 and 2021 (until August) are shown below.

Figure 2 – Remote participation and e-meetings

## 7.1 Statutory meetings

Statutory meetings held virtually from January to September 2021:

| **Dates** | **Meeting** | **Remarks** |
| --- | --- | --- |
| 6-7 January 2021 | ITU-T SG12 | In English only without interpretation. |
| 7 January 2021 | ITU-T SG17 | In English only without interpretation. |
| 8 January 2021 | IRM - Interregional meeting for preparation of WTSA | Interpretation in all official ITU languages on MyMeetings, with captioning for all sessions. |
| 11-18 January 2021 | TSAG | Interpretation in all official ITU languages on MyMeetings, with captioning for all sessions. |
| 1-12 March 2021 | ITU-T SG13 | In English only without interpretation. |
| 17-26 March 2021 | ITU-T SG11 | Interpretation was available in English and Russian on the opening and closing plenaries. |
| 12-23 April 2021 | ITU-T SG15 | In English only without interpretation. |
| 19-28 April 2021 | ITU-T SG9 | In English only without interpretation. |
| 19-30 April 2021 | ITU-T SG16 | In English only without interpretation, with sign language interpretation and captioning. |
| 20-30 April 2021 | ITU-T SG17 | Closing plenary in English only without interpretation, with captioning. |
| 04-13 May 2021 | ITU-T SG12 | In English only without interpretation. |
| 11-20 May 2021 | ITU-T SG5 | Interpretation in four ITU official languages for the closing plenary. |
| 17-27 May 2021 | ITU-T SG20 | In English only without interpretation. Captioning was provided for the opening and closing plenaries of SG20, WP1/20, and WP2/20 and a number of Q2/20 sessions. |
| 24-28 May 2021 | ITU-T SG3 | Interpretation in Arabic, English, and French for entire meeting. |
| 31 May - 11 June 2021 | ITU-T SG2 | In English only without interpretation. Captioning was provided for the SG2 and WP1/2 and SG2 plenary sessions, and a number of Q1/2 sessions. |
| 15-16 July 2021 | WP1/11, WP2/11 and WP3/11 | In English only without interpretation. |
| 16 July 2021 | WP1/13, WP2/13 and WP3/13 | In English only without interpretation. |
| 24 August - 03 September 2021 | ITU-T SG17 | In English only without interpretation, with captioning. |
| 27 September 2021 | ITU-T SG16 | Planned. |
| 11-21 October 2021 | ITU-T SG20 | Interpretation will be available for the closing plenary of the meeting if requested by Member States. Captioning will be provided for the opening and closing plenaries of SG20, WP1/20, and WP2/20 and all Q2/20 sessions. |
| 12-21 October 2021 | ITU-T SG12 | Planned. |
| 21 October 2021 | IRM - Interregional meeting for preparation of WTSA | Planned. Interpretation in all official ITU languages on Zoom, with captioning for all sessions. |
| 25-29 October 2021 | TSAG | Planned. Interpretation in all official ITU languages on Zoom during opening and closing plenaries, with captioning for all sessions. |

## 7.2 Workshops and symposia

Participation in ITU workshops and symposia has increased considerably in 2021. With all ITU-T workshops and symposia held virtually, open ITU-T events are welcoming a greater number and diversity of participants.

ITU workshops and symposia organized from January to September 2021:

|  | **Title of Event** | **Place, Dates** |
| --- | --- | --- |
|  | [**Regulatory Framework for Automated Driving: The Value of in-use Data for Creating a no-blame Culture of Safety**](https://aiforgood.itu.int/events/a-regulatory-framework-for-automated-driving-the-value-of-in-use-data-for-creating-a-no-blame-culture-of-safety/) | Virtual, 2 March 2021 |
|  | [A regulatory framework for automated driving: the value of in-use data for creating a no-blame culture of safety](https://aiforgood.itu.int/event/a-regulatory-framework-for-automated-driving-the-value-of-in-use-data-for-creating-a-no-blame-culture-of-safety/) (under the AI for Good Summit) | Virtual, 2 March 2021 |
|  | [DLT Meet-up Episode #6: DLT Authentication](https://www.itu.int/en/ITU-T/webinars/20210303/Pages/default.aspx) | Virtual, 3 March 2021 |
|  | [**ITU-ETSI-IEEE Joint SDOs Brainstorming Workshop on Testbeds Federations for 5G and Beyond: Interoperability, Standardization, Reference Model and APIs**](https://www.itu.int/en/ITU-T/Workshops-and-Seminars/20210316/Pages/default.aspx) | Virtual, 15-16 March 2021 |
|  | [**ITU /WMO Workshop on AI for Natural Disaster Management and First meeting of ITU-T Focus Group on AI for Natural Disaster Management (FG-AI4NDM)**](https://www.itu.int/en/ITU-T/Workshops-and-Seminars/20210315/Pages/default.aspx) | Virtual, 15-17 March 2021 |
|  | QIT Webinar Series- Episode #1: [**Joint Symposium on Standards for Quantum Technologies**](https://www.itu.int/en/ITU-T/Workshops-and-Seminars/2021/0323/Pages/default.aspx) | Virtual, 23 March 2021 |
|  | [**Future Networked Car Symposium (FNC 2021)**](https://www.itu.int/en/fnc/2021/Pages/default.aspx) | Virtual, 22-25 March 2021 |
|  | [**Digital Currencies and Financial Inclusion Webinar**](https://www.itu.int/en/ITU-T/webinars/20210329/Pages/default.aspx) | Virtual, 29 March 2021 |
|  | [**DLT Meet-up Episode #7: Change Management DLT-Based Decentralized Applications**](https://www.itu.int/en/ITU-T/webinars/20210407/Pages/default.aspx) | Virtual, 7 April 2021 |
|  | [Artificial Intelligence (AI) for sustainable transformation in smart cities, mobility & energy](https://aiforgood.itu.int/events/ai-for-sustainable-transformation-in-smart-cities-mobility-and-energy/) | Virtual, 7 April 2021 |
|  | [QIT Webinar Series-Episode #2: Cybersecurity in the quantum era](https://www.itu.int/net4/wsis/forum/2021/Agenda/Session/266) | Virtual, 8 April 2021 |
|  | [Special Session on Implementation aspects of Vehicular Multimedia](https://www.itu.int/en/ITU-T/focusgroups/vm/Pages/12-04_Special-session.aspx) | **Virtual, 12 April 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 Workshop on "The Future of Television for Asia & Pacific"](https://www.itu.int/en/ITU-T/Workshops-and-Seminars/202004/Pages/default.aspx) | **Virtual, 23 April 2021** |
|  | [**QIT Webinar Series- Episode #3: "Joint Symposium on Quantum Transport Technology''**](https://www.itu.int/en/ITU-T/webinars/20210428/Pages/default.aspx) | **Virtual, 28 April 2021** |
|  | [**Virtual Forum on Human Exposure to electromagnetic fields (EMFs) due to digital technologies**](https://www.itu.int/en/ITU-T/Workshops-and-Seminars/2021/0510/Pages/default.aspx) | **Virtual, 10 May 2021** |
|  | [DLT Meet-up Episode #8: Trusted DLT and Hardware Integration](https://www.itu.int/en/ITU-T/webinars/20210512/Pages/default.aspx) | Virtual, 12 May 2021 |
|  | [QIT Webinar Series - Episode #4: "Quantum Information Technology (QIT) for networks – Use cases"](https://www.itu.int/en/ITU-T/webinars/20210526/Pages/default.aspx) | Virtual, 26 May 2021 |
|  | [**Joint ITU/MWF Webinar "Combating Counterfeit and Irregular Mobile Devices: How to address the Problem"**](https://www.itu.int/en/ITU-T/webinars/20210531/Pages/default.aspx) | Virtual, 31 May 2021 |
|  | [**Eighth SG13 Regional Workshop for Africa "Standardization and Future Networks: Opportunities for Africa beyond 2020"**](https://www.itu.int/en/ITU-T/Workshops-and-Seminars/20210601/Pages/default.aspx) | Virtual, 1 June 2021 |
|  | [AI policy, standards and metrics for automated driving safety](https://aiforgood.itu.int/event/ai-policy-standards-and-metrics-for-automated-driving-safety/) (under the AI for Good Summit) | Virtual, 2 June 2021 |
|  | [ITU-T SG20 RG-AFR Virtual Forum on “Accelerating Digital Transformation in Africa”](https://www.itu.int/en/ITU-T/climatechange/Pages/20210602.aspx) | Virtual, 2 June 2021 |
|  | [DLT Meet-Up Episode #9: DLT Standardization: A technical framework for regulatory compliance](https://www.itu.int/en/ITU-T/webinars/20210602/Pages/default.aspx) | Virtual, 2 June 2021 |
|  | [**ITU Workshop on Regulatory Aspects of Telecommunication Service Quality in Latin America**](https://www.itu.int/en/ITU-T/Workshops-and-Seminars/qos/20210602/Pages/default.aspx) | Virtual, 2 - 4 June 2021 |
|  | [**Joint ETSI ISG F5G, BBF, CCSA TC6 and ITU-T SG15 Workshop on "FTTR" (Fibre to the room)**](https://www.itu.int/en/ITU-T/Workshops-and-Seminars/2021/0614/Pages/default.aspx) | Virtual, 14 June 2021 |
|  | [IEC-ISO-ITU Joint Smart Cities Task Force (J-SCTF) Forum on "Strengthening IEC, ISO and ITU collaboration for Smart Cities"](https://www.itu.int/en/ITU-T/Workshops-and-Seminars/2021/0621/Pages/default.aspx) | Virtual, 21 June 2021 |
|  | [Side event: International Standards and Sustainable Green & Innovative Power Solutions to bring Broadband Internet Connectivity to Rural and Remote Areas](https://www.itu.int/en/action/environment-and-climate-change/Pages/Side-event-International-Standards-and-Sustainable-Green-%26-Innovative-Power-Solutions.aspx) | 22 June 2021 |
|  | [**ITU/WHO Workshop on "The role of industry in making telehealth accessible for persons with disabilities"**](https://www.itu.int/en/ITU-T/Workshops-and-Seminars/dh/202106/Pages/default.aspx) | Virtual, 23 June 2021 |
|  | [**QIT Webinar Series - Episode #5: "Harmonization of Terminology in Standards for Quantum Technology"**](https://www.itu.int/en/ITU-T/webinars/20210623/Pages/default.aspx) | Virtual, 23 June 2021 |
|  | [Second ITU/WMO/UNEP Workshop on AI for Natural Disaster Management](https://www.itu.int/en/ITU-T/Workshops-and-Seminars/2021/0623/Pages/default.aspx) | Virtual, 23 June 2021, |
|  | [**Financial Inclusion Global Initiative (FIGI) 2021**](https://figi.itu.int/) | Virtual, 18 May- 24 June 2021 |
|  | [**ITU Workshop on "Protocol Enhancements for IMS to be used in LTE/IMT-2020 Networks and Beyond"**](https://www.itu.int/en/ITU-T/Workshops-and-Seminars/2021/0705/Pages/default.aspx) | Virtual, 5 July 2021 |
|  | "Decentralized identifiers and blockchain" session during [**BDT Emerging Technology Week 2021**](https://www.itu.int/en/ITU-D/Conferences/ET/2021/Pages/Programme.aspx) | Virtual, 5 July 2021 |
|  | [VEF Side Event: Unlocking the potential of digital technologies for a sustainable energy transition](https://www.itu.int/en/ITU-T/studygroups/2017-2020/05/Pages/ITU-T-SG5-side-event-on-Vienna-Energy-Forum.aspx) | Virtual, 6 July 2021 |
|  | "Emerging technology for telecommunications in disaster management" session during [**BDT Emerging Technology Week 2021**](https://www.itu.int/en/ITU-D/Conferences/ET/2021/Pages/Programme.aspx) | Virtual, 6 July 2021 |
|  | Artificial intelligence for health session during [**BDT Emerging Technology Week 2021**](https://www.itu.int/en/ITU-D/Conferences/ET/2021/Pages/Programme.aspx) | Virtual, 9 July 2021 |
|  | [**DLT Meet-Up Episode #10: Industrial and Energy Use Cases**](https://www.itu.int/en/ITU-T/webinars/20210804/Pages/default.aspx) | Virtual, 4 August 2021 |
|  | [**ITU/WHO Workshop on "Digital Vaccination Certificate"**](https://www.itu.int/en/ITU-T/Workshops-and-Seminars/2021/0811/Pages/default.aspx) | Virtual, 11 August 2021 |
|  | [**Third ITU/WMO/UNEP Workshop on Artificial Intelligence for Natural Disaster Management**](https://www.itu.int/en/ITU-T/Workshops-and-Seminars/2021/0830/Pages/default.aspx) | Virtual, 30 August 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 |
|  | [**Digital Transformation for Cities and Communities (DT4CC) Webinar Series - Episode #1: Digital Twin in Cities**](https://www.itu.int/en/ITU-T/webinars/202109/Pages/default.aspx) | Virtual, 8 September 2021 |
|  | [**ITU Workshop on Performance, Quality of Service and Quality of Experience**](https://www.itu.int/en/ITU-T/Workshops-and-Seminars/qos/20210908/Pages/default.aspx) | Virtual, 8-9 September 2021 |
|  | [**DT4CC Webinar Series - 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 Webinar Series - 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 Webinar Series - Episode #4: Smart Cities: A step towards digital transformation in Latin America**](https://www.itu.int/en/ITU-T/webinars/20210920/Pages/default.aspx) | Virtual, 20 September 2021 |
|  | [**DT4CC Webinar Series - 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 |
|  | [**Sustainable Digital Transformation Dialogues**](https://www.itu.int/en/ITU-T/Workshops-and-Seminars/sg05rg/sdtd/Pages/default.aspx) | Virtual, 28-30 September 2021 |
|  | [**AI for road safety**](https://aiforgood.itu.int/event/ai-for-road-safety/) **(under the AI for Good Summit and in partnership with FG-AI4AD)** | Virtual, 6 October 2021 - Planned |
|  | DLT Meet- Ups- Episode #11: DLT Interoperability Onchain X Offchain | Virtual, 13 October 2021 - Planned |
|  | Dialogue on Sustainable Digital Transformation in Asia and the Pacific | Virtual, 19 October 2021 - Planned |
|  | FG-AI4EE Webinar on AI for Environmental Sustainability | Virtual, 20 October 2021 - Planned |
|  | [Dialogue on Sustainable Digital Transformation in Africa](https://www.itu.int/en/ITU-T/Workshops-and-Seminars/sg05rg/sdtd/20210928/Pages/default.aspx) | **28 September 2021 - Planned** |
|  | [Dialogue on Sustainable Digital Transformation in the Arab region](https://www.itu.int/en/ITU-T/Workshops-and-Seminars/sg05rg/sdtd/20210929/Pages/default.aspx) | **29 September 2021 - Planned** |
|  | Dialogue on Sustainable Digital Transformation in Latin America | **30 September 2021 - Planned** |
|  | [**DT4CC Webinar Series - Episode #6: Smart City Platforms**](https://www.itu.int/en/ITU-T/webinars/20211101/Pages/default.aspx) | Virtual, 1 November 2021 - Planned |
|  | [**DT4CC Webinar Series - Episode #7: Crowdsourced Systems: A people-led paradigm**](https://www.itu.int/en/ITU-T/webinars/20211102/Pages/default.aspx) | Virtual, 2 November 2021 - Planned |
|  | QIT Webinar Series - Episode #6: "Joint Symposium on Quantum Photonic Integrated Circuits (QPICS)" | Virtual, date tbc, 1st of Nov 2021  |
|  | DT4CC Webinar Series - Episode #8: Network capabilities and emerging technologies to support IoT-enabled verticals | Virtual, 18 November 2021 – Planned |
|  | [**ITU Workshop on "The Future of Television for Europe"**](https://www.itu.int/en/ITU-T/Workshops-and-Seminars/2021/1119/Pages/default.aspx) | Virtual, 19 November 2021 - Planned |
|  | [**DT4CC Webinar Series - 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 - Planned |
|  | [**DT4CC Webinar Series - 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 - Planned |
|  | [**DT4CC Webinar Series - 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 - Planned |
|  | [**DT4CC Webinar Series - Episode #12: Interoperability of IoT and satellite data for Earth observation supporting sustainable development**](https://www.itu.int/en/ITU-T/webinars/20210909/Pages/default.aspx) | Virtual, 14 December 2021 - Planned |
|  | Digital Currency Global Initiatives Webinar Series | Dates to be confirmed |
|  | 2nd ITU/WHO Workshop on Digital COVID-19 Certificate | Dates to be confirmed |

# 8 Bridging the standardization gap

ITU's Bridging the Standardization Gap (BSG) programme improves the capacity of developing countries to participate in the development and implementation of international ICT standards.

WTSA-16 agreed an Action Plan to address further the disparity in standardization between developed and developing countries, including least-developed countries, Small Island Developing States (SIDS) and countries with economies in transition.

The revamped BSG Programme is structured around five pillars, responding to WTSA Resolution 44. The five pillars of the BSG programme include: Engagement, know-how, community, awareness, and partnering:

1. **Engagement** is about facilitating participation in standards development. This includes fellowship and mentorship programmes and tools for remote participation.
2. **Know-how** covers the development of skills and capabilities for standards-making. This includes standards-making effectiveness sessions, video tutorials and e-learning courses.
3. **Community** focused on empowerment at regional and national levels. Regional Groups within ITU-T SGs are a prime example, ensuring that standards-making is inclusive of the needs of all regions.
4. **Awareness** covers information sharing, using ITU-T publications on a wide range of topics as well as Regional and Inter-Regional standardization forums.
5. **Partnering** is about mobilizing resources and fostering collaboration.



Figure 3 - Five pillars of the BSG Programme

## 8.1 BSG hands-on training sessions

ITU-T regularly carries out 'BSG Hands-On SG effectiveness training' in response to WTSA Resolution 44. These trainings focus on the development of practical skills to maximize the effectiveness of developing countries' participation in the ITU-T standardization process, covering topics including strategies for participation in SGs, drafting contributions to meetings, presenting proposals, collaborative working methods, building consensus and utilization of TSB tools and services.

Since October 2020, these BSG training sessions have welcomed 128 delegates. In 2021, the following virtual BSG trainings have been held/planned in collocation with relevant Study Group meeting:

* 12 February 2021 – BSG Training for SG1316 March 2021 – BSG Training for SG11
* 22 April 2021 – BSG Training for SG17
* 6 May 2021 - BSG Training for SG20 and SG5
* 10 May 2021 – BSG Training for SG2
* 26 August 2021 – BSG Training for SG17
* 4 October 2021 – BSG Training for SG20 and SG5 (planned)
* 30 November 2021 – BSG Training for SG11 and SG13 (planned).

With the shift to fully virtual ITU-T meetings in response to COVID-19, additional (online) trainings are being planned for the remaining quarter of 2021.

**8.1.1 BSG training on services and tools**

On occasion, TSB also offers trainings on the use of TSB services and tools. These trainings introduce services and tools including remote participation, MyWorkspace and publications. Such BSG trainings facilitate more active and efficient participation in ITU-T work, particularly in view of the upcoming WTSA-20. For more on TSB services and tools, see section 10.

## 8.2 Regional Groups

Regional Groups within ITU-T SGs have proven effective mechanisms to coordinate regional contributions to ITU and increase the number and quality of technical contributions from developing countries. More than 400 participants attended the 16 Regional Group meetings held since October 2020:

* Six in Africa (SGs 2, 3, 12, 13, 17, and 20)
1. SG2-RG-AFR (Joint meeting with SG2RG-ARB): 17 May 2021
2. SG3-RG-AFR: 6-9 April 2021.
3. SG12-RG-AFR: 7 September 2021
4. SG13-RG-AFR: 2 June 2021
5. SG20-RG-AFR: 3 June 2021
6. SG17RG-AFR: 28 September 2021
* Five for the Americas (SGs 2, 3, 5, and 20)
	1. **SG2-RG-AMR: 7 September 2021**
	2. **SG3-RG-LAC: 12-13 April 2021**
	3. **SG5-RG-LATAM: 10 November 2020**
	4. **SG20-RG-LATAM: 13-14 October 2020**
	5. **SG20-RG-LATAM: 20 September 2021**
* Two for the Arab States (SGs 2, and 3)
1. SG2-RG-ARB (Joint meeting with SG2RG-AFR): 17 May 2021
2. SG3-RG-ARB: 20 April 2021
* Three for Asia and Oceania (SGs 3, and 5)
1. SG3-RG-AO: 12-14 April 2021
2. SG5-RG-AP: 29-30 September 2020
3. SG5-RG-AP: 15-16 April 2021
* One for Eastern Europe, Central Asia and Transcaucasia.

1. SG20-RG-EECAT: Minsk, Belarus, 16-18 March 2021.

## 8.3 Regional Standardization Forums

Regional Standardization Forums (RSFs) provide tutorials on ITU-T working methods as well as more technically-oriented themes such as human exposure to electromagnetic fields, quality of service, smart water management, international mobile roaming, mobile financial services, digital identity, big data, and security and trust.

RSFs are being held in conjunction with meetings of Regional Groups to improve the alignment of RSF discussions and the priorities of ITU-T SGs. RSFs are also raising awareness of ITU standardization activities through the participation of key decision-makers (Prime Ministers, Ministers, Heads of Regulators, CEOs, etc.).

No [ITU Regional Standardization Forums (RSF)](https://www.itu.int/en/ITU-T/Workshops-and-Seminars/bsg), and three regional ITU workshops, and one regional webinar took place during the reporting period:

* 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.
* Forum on "[Accelerating Digital Transformation in Africa](https://www.itu.int/en/ITU-T/climatechange/Pages/20210602.aspxhttps%3A/www.itu.int/en/ITU-T/climatechange/Pages/20210602.aspx)", virtual, 2 June 2021.
* Eighth SG13 Regional Workshop for Africa "[Standardization and Future Networks: Opportunities for Africa beyond 2020](https://www.itu.int/en/ITU-T/climatechange/Pages/20210602.aspxhttps%3A/www.itu.int/en/ITU-T/climatechange/Pages/20210602.aspx)", virtual, 1 June 2021.
* One regional ITU webinar on "[Smart Cities: a step towards digital transformation in Latin America](https://www.itu.int/en/ITU-T/webinars/20210920/Pages/default.aspx)" will take place on 20 September 2021.

## 8.4 National Standardization Secretariats

ITU-T’s [new Guidelines for National Standardization Secretariats (NSS)](https://www.itu.int/en/ITU-T/gap/Documents/nss-rep-may.pdf) take into account the membership feedback on the Guidelines first published in 2014. The Guidelines set out a number of options for developing national procedures and processes to support effective participation in the ITU-T standards-development process. An NSS, as described by the Guidelines, is the full set of arrangements by which participation in and contributions to ITU-T are coordinated within a country.

An extensive set of functions that an NSS could perform are presented, enabling a country to select functions and organizational arrangements in a modular fashion, considering factors such as its ICT standardization policies; the number and type of organizations with an interest in ICT standardization in the country (e.g., number of service providers, equipment manufacturers, and academic and research institutes); and the level of participation in ITU-T SGs (e.g., whether as an initiator of work items, active contributor or observer in one or more ITU-T SGs).

## 8.5 e-Learning courses

One of the BSG measures adopted under WTSA Resolution 44 calls for the exploration of e-learning channels for training on ITU-T Recommendations. These training courses are available on the ITU Academy website at <http://academy.itu.int>.

## 8.6 SG Mentoring Programme

In 2011, a mentoring programme for ITU-T SGs was introduced. The objective of the mentoring programme is to provide a contact point to assist new delegates with the working methods of ITU-T and to facilitate participation and contributions from developing countries. It has since featured as an important part of the work of ITU-T SGs and TSAG.

## 8.7 Technical Papers

A series of Technical Papers and Technical Reports provide additional information for developing countries on best practices in implementing ITU-T Recommendations. See the Technical Reports [web page](https://www.itu.int/pub/T-TUT).

SG15 recently agreed the following new Technical Papers:

– ITU-T GSTP-HNAFS "Architecture, function and service of home network"

– ITU-T GSTP-FTTR "Use Case & Requirements of Fibre-to-The-Room (FTTR)"

– ITU-T LSTP-GLSR "Guide on the use of ITU-T L-series Recommendations related to optical technologies for outside plant".

SG16 recently agreed the following new Technical Papers:

* Technical Paper [ITU-T FSTP.SS-OTA](https://www.itu.int/pub/publications.aspx?lang=en&parent=T-TUT-ITS-2021-OTA) provides an overview of a survey for standardization of over-the-air updating in vehicles.
* Technical Paper [ITU-T HSTP.ACC-UC](https://www.itu.int/pub/publications.aspx?lang=en&parent=T-TUT-FSTP-2021-ACC.UC) describes use cases for inclusive media access services
* Technical Paper [ITU-T HSTP-CONF-H870](https://www.itu.int/pub/publications.aspx?lang=en&parent=T-TUT-EHT-2021-CONFH870) provides conformance testing specifications for personal audio systems that follow the ITU/WHO standard ITU-T H.870 on safe listening devices and systems.

SG17 recently agreed the following new Technical Papers/Technical Reports:

* Security in telecommunications and information technology (7th edition)
* TP.inno "Description of the incubation mechanism and ways to improve it"
* TR.sgstruct "Strategic approaches to the transformation of security studies"
* TR.suss-rev "Successful use of security standards" (2nd edition)
* TR.usm "Unified Security Model (USM) - a neutral integrated system approach to Cybersecurity"
* TR.XAASL "Technical Report: Framework for security standardization for virtualized services"

## 8.8 Fellowships

No fellowships were awarded during the period from January to September 2021, since no face-to-face meetings took place.

# 9 Publications

## 9.1 Recommendations and Supplements

Over 5,000 pages of ITU-T Recommendations and Supplements were published between January and September 2021. Figure 4 illustrates the number of Recommendations (including Supplements) published per year since 2016, noting that 2021 covers only until mid-September.

All major editions of ITU-T Recommendations continue to be converted to the reflowable ePub format, and are published for free download alongside the usual PDF format. The ePub format allows users to read the Recommendations on devices of different screen sizes, and also to apply functions such as bookmarks, notes and highlights.

As approved by TSAG, most corrigenda and amendments to ITU-T Recommendations are now integrated into the main edition. The changes introduced by the amendment or corrigendum are shown with revision marks.

The ITU product "ITU-T Recommendations and selected Handbooks" continues to be distributed on a quarterly basis as a USB key. This product represents a tool of great value to standards developers and implementers as a consolidated archive of the over 4,000 ITU-T standards in force.

**Figure 4 – Number of Recommendations, amendments and Supplements**
**published per year since 2016**

## 9.2 Official languages of the Union on an equal footing

The Standardization Committee for Vocabulary (SCV), composed of ITU-T members expert in all the official languages, serves as focal point to ITU-T SGs in terminology-related matters. SCV guides the adoption of terms and definitions in ITU-T Recommendations in accordance with WTSA Resolution 67.

TSB continues to collect all new terms and definitions proposed by ITU-T SGs, entering them into the online ITU Terms and Definitions database.

As requested by WTSA Resolution 67, TSB continues to translate all Recommendations approved under the Traditional Approval Process (TAP) as well as all TSAG reports.

TSB also translated eight AAP Recommendations so far in 2021, in accordance with requests received from ITU-T SGs and linguistic groups, and within the available budget.

# 10 Services and tools

Electronic working methods offer crucial support to members engaged in ITU-T standardization work. TSB is continuously developing new applications and services, while enhancing existing services, to maintain and expand ITU-T's advanced electronic working environment.

## 10.1 ITU-T databases

Following databases are made available for ITU-T delegates and secretariat staff:

* [ITU-T Work Programme](http://www.itu.int/ITU-T/workprog)
* [ITU-T A.4, A.5 and A.6 recognized organizations](https://www.itu.int/en/ITU-T/extcoop/Pages/sdo.aspx)
* [ITU-T AAP](https://www.itu.int/ITU-T/aap/AAPSearch.aspx) & [TAP](https://www.itu.int/net/ITU-T/lists/t-approval.aspx)
* [ITU-T Recommendations](http://www.itu.int/itu-t/recommendations)
* [ITU-T Liaison Statements](https://www.itu.int/net/itu-t/ls/ils.aspx?to=3936&meeting=T17-TSAG-211025)
* [ITU-T Patents and Software Copyrights](http://www.itu.int/ipr/)
* [ITU Product Conformity Database](http://www.itu.int/net/itu-t/cdb/ConformityDB.aspx)
* [ITU-T Formal Descriptions and Object Identifiers](http://www.itu.int/ITU-T/formal-language/index.html)
* [ITU-T Test Signals](http://www.itu.int/net/itu-t/sigdb/menu.htm)
* [ITU-T Terms & Definitions](http://www.itu.int/ITU-R/go/terminology-database)
* [International Numbering Resources](http://www.itu.int/ITU-T/inr/index.html) (See section 10.6 for more details)
* [ICT standards landscape](https://www.itu.int/net4/ITU-T/landscape#?topic=0&workgroup=1&searchValue=&page=1&sort=Revelance):
	+ Access Network Transport Standards
	+ Cloud Computing
	+ Home Network Transport Standards
	+ ICT Security Standards
	+ IMT-2020 and beyond (and [Software-Defined Networking (SDN)](https://www.itu.int/net4/ITU-T/landscape))
	+ IoT & Smart Sustainable Cities Standards
	+ ITS Communication Standards.

## 10.2 MyWorkspace

[MyWorkspace](https://www.itu.int/myworkspace/) is a user-friendly mobile platform that centralizes a set of applications and services developed to strengthen electronic working methods for the work of ITU-T, as stated in WTSA Resolution 32. Since the first version was released in 2017, more than 4000 users have visited it, with an average of 500 visits per month. Secure access to MyWorkspace is enabled through ITU User Account (TIES) credentials.

The following applications and services are available in MyWorkspace:

* [ITU Translate](https://www.itu.int/myworkspace/#/Translate): Machine translation tool based on neural network, trained in-house on ITU documents official translations and supporting all six (6) UN official languages.
* [MyMeetings](https://www.itu.int/myworkspace/#/MyMeetings): Remote participation service based on an open-source solution and customized in-house to support requirements of both statutory and non-statutory ITU-T meetings.
* Documents:
	+ - [MyDocuments](https://www.itu.int/myworkspace/#/Documents/MyDocuments/meeting=T17-TSAG-211025&search=&type=&sources=&questions=): Simplified access to Study Group documents, per meeting, with multiple sorting and selection filters and full text search, and automatic translation from English into 5 others official ITU languages (available on request).
		- [Suggested documents](https://www.itu.int/myworkspace/#/Documents/Suggested-Documents): A proposed list of documents based on pre-set user interests, with the option to bookmark favourites.
* [Calendar](https://www.itu.int/myworkspace/#/Calendar): Monthly calendar view of all ITU events with filters on ITU sectors and ITU-T working groups, with detailed information.
* [MyEvents](https://www.itu.int/myworkspace/#/Myevents): Events management platform, which provides real time ITU-T events agenda, list of registered participants, speakers and exhibitors, as well as a ‘matchmaking’ function to enable networking among participants.
* [Mailing list](https://www.itu.int/myworkspace/#/Mailing): Subscription management with search functionality.
* [Community](https://www.itu.int/myworkspace/#/Community): MyWorkspace user’s directory.
* [ITU-T Cloud](http://tsbcloud.itu.int): ITU premises storage service allowing users to share and exchange up to 10 GB of files per user.
* [Profile](https://www.itu.int/myworkspace/#/profile): User personal information and interests.

## 10.3 ITU-T services & tools

The [Electronic Working Methods (EWM) webpage](https://www.itu.int/en/ITU-T/ewm/Pages/default.aspx) keeps the ITU-T community up to date with the latest available tools and service enhancements, which it now summarises more clearly. The [Announcements and Updates webpage](https://www.itu.int/en/ITU-T/ewm/Pages/EWM-Updates.aspx) now regularly presents service changes. The Electronic Working Methods section of the [ITU-T Resources webpage](https://www.itu.int/en/ITU-T/info/Pages/resources.aspx) provides more useful links to the most common tools.

## 10.4 Document Management System for Rapporteur Groups

The Microsoft SharePoint-based Document Management System for ITU-T Rapporteur Group Meetings (RGMs) has been used extensively by the majority of ITU-T SGs, notably SGs 2, 3, 9, 11, 13, 15, 16, 17 and TSAG. Feedback from Rapporteurs drives the continuous improvement of the RGM system.

Current and past RGM meetings can be accessed at <http://itu.int/go/itu-t/rgm>

A comprehensive support and FAQs page offering RGM tips and best practices is available at <http://itu.int/go/itu-t/rgm-support>

A detailed online user guide for the RGM System, including video tutorials, is available at <http://itu.int/go/itu-t/rgm-guide>

The RGM system is one of several services available in the ITU-T SharePoint collaboration sites. These sites are restricted to ITU-T members and can be accessed using an ITU User Account (TIES).

## 10.5 International Numbering Resources (INRs)

ITU assigns about two-dozen types of International Numbering Resources (INRs), either directly or indirectly.

Notifications of national numbering/identification plan updates and assignments or reclamations of national numbering/identification resources are received and published in the [ITU Operational Bulletin](http://www.itu.int/pub/T-SP-OB). The ITU Operational Bulletin is published in the six official languages of the Union twice a month. Some 20 annexes are maintained on numbers and codes allocated in accordance with the following recommendations:

* ITU-T E.164 "The international public telecommunication numbering plan"
* ITU-T E.118 "The international telecommunication charge card"
* ITU-T E.212 "The international identification plan for public networks and subscriptions"
* ITU-T E.218 "Management of the allocation of terrestrial trunk radio Mobile Country Codes"
* ITU-T Q.708 "Assignment procedures for international signalling point codes".

## 10.6 ITU-T SharePoint collaboration sites

The ITU-T SharePoint collaboration sites enable participants in ITU-T working groups to conduct online discussions, work on projects, schedule meetings and manage and store documents in a secure shared environment.

The home of ITU-T SharePoint collaboration sites can be accessed at: <https://extranet.itu.int/sites/ITU-T/>.

A selection of notable collaboration sites is listed below:

* ITU-T SGs (Study Period 2017-2021) (<https://extranet.itu.int/sites/itu-t/studygroups/2017-2020>)
* United for Smart Sustainable Cities (U4SSC) (<https://extranet.itu.int/sites/itu-t/initiatives/U4SSC/>)
* Security, Infrastructure and Trust Working Group (SIT WG) (<https://extranet.itu.int/sites/itu-t/initiatives/sitwg/>)
* FG-AI4AD – ITU-T Focus Group on Autonomous and Assisted Driving (<https://extranet.itu.int/sites/itu-t/focusgroups/ai4ad>)
* FG-AI4EE – Focus Group on Environmental Efficiency for AI and other Emerging Technologies
(<https://extranet.itu.int/sites/itu-t/focusgroups/ai4ee/>)
* FG-AI4H – ITU-T Focus Group on AI for Health (<https://extranet.itu.int/sites/itu-t/focusgroups/ai4h/>)
* FG-AN – ITU-T Focus Group on Autonomous Networks (<https://extranet.itu.int/sites/itu-t/focusgroups/an/SitePages/Home.aspx>)
* FG-AI4NDM – ITU-T Focus Group on Artificial Intelligence for Natural Disaster Management (<https://extranet.itu.int/sites/itu-t/focusgroups/ai4ndm/SitePages/Home.aspx>)
* FG-QIT4N – ITU-T Focus Group on Quantum Information Technology for Networks (<https://extranet.itu.int/sites/itu-t/focusgroups/qit4n>)
* FG-VM – ITU-T Focus Group on Vehicular Multimedia
(<https://extranet.itu.int/sites/itu-t/focusgroups/vm/>)
* JVDS – ITU-T SG16 & ISO TC22/SC31/WG8 Joint Project Team on Vehicle Domain Service (<https://extranet.itu.int/sites/itu-t/jointgroups/jvds/>)
* IRG-AVA - Intersector Rapporteur Group on Audiovisual Media Accessibility (<https://extranet.itu.int/sites/irg/ava/>)
* CASC – ITU-T Conformity Assessment Steering Committee
(<https://extranet.itu.int/sites/itu-t/studygroups/2017-2020/sg11/casc/>)
* Pathway #1: Circular Design (<https://extranet.itu.int/sites/itu-t/initiatives/circulardesign>)
* Digital Currency Global Initiative (<https://extranet.itu.int/sites/itu-t/initiatives/dcgi>)
* Project on E-waste (<https://extranet.itu.int/sites/itu-t/initiatives/E-waste>)
* Focal points and coordinators for WTSA-20 from regional organizations (<https://extranet.itu.int/sites/itu-t/wtsa-20/prepmeet/Lists/ContactSheet/DefViewContacts.aspx>)
* [Numbering Applications Monitor](https://extranet.itu.int/sites/itu-t/studygroups/2017-2020/sg2/SitePages/Numbering%20Applications%20Monitor.aspx)

A support site containing a knowledge base of FAQs and user guides on the various SharePoint services is available at: <https://extranet.itu.int/ITU-T/support/>.

Most of the collaboration sites are restricted to ITU-T members, accessed using an ITU User Account (TIES). Certain collaboration sites are open to non-members, accessed using non-member ITU User Accounts.

# Appendix I – List of approved Recommendations and other approved texts

NOTE – Corrigenda are not listed here.

I.1.1 G.fast and DSL: Breathing new life into existing copper infrastructure

[**ITU-T G.994.1 Amd.2 “Handshake procedures for digital subscriber line transceivers - Amendment 2”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=14493) fully integrates the Amendment 1 to Recommendation ITU-T G.994.1 (2018) and includes the following new technical material:

- A new annex with a collision control protocol for point-to-multipoint operation

- Modify the mandatory carrier set for G.9701 Annex X with operation over coax

- A new annex M with managed objects in a new format compatible with a YANG model

- Add codepoints for the support of G.9711.

[**ITU-T G.997.3 “Physical layer management for MGfast transceivers”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=14512) specifies the physical layer management for Multi-gigabit fast access to subscriber terminals (MGfast) transmission systems. It specifies managed objects for configuration, fault, status, inventory and performance management.

[**ITU-T G.9711 “Multi-gigabit fast access to subscriber terminals (MGfast) - Physical layer specification (New)”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=14513)specifies a multi-gigabit broadband access technology that exploits the existing infrastructure of wire-pairs and coaxial cable that were originally deployed for plain old telephone service (POTS) or TV services. Equipment implementing this Recommendation can be deployed from fibre-fed distribution points (fibre to the distribution point, FTTdp) located in close proximity to customer premises, or within buildings, including MDUs and business facilities (fiber to the building). This Recommendation supports asymmetric and symmetric transmission at an aggregate net data rate up to 8 Gbit/s on metallic wires using spectrum up to 424 MHz and provides functionalities for far-end crosstalk (FEXT) and near-end crosstalk (NEXT) cancellation between multiple wire-pairs.

I.1.2 Ultra-high-speed optical access

[**ITU-T G.987.3 Amd.2 “10-Gigabit-capable passive optical networks (XG-PON): Transmission convergence (TC) layer specification - Amendment 2”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=14622) aligns the ODN class table in G.987.3 to that recently added to G.9807.1. It also fixes some small graphical errors in the figures.

[**ITU-T G.988 (2017) Amd.4 “ONU management and control interface (OMCI) specification: Amendment 4”**](https://www.itu.int/rec/T-REC-G.988-202109-I%21Amd4) specifies the optical network unit (ONU) management and control interface (OMCI) for optical access networks. This amendment makes editorial changes to TWDM channel tuning performance history data part 1, TWDM channel managed entity and clause 9.2.21. Amendment 4 also adds:

• Support of RFC 2543 call hold (with connection address 0.0.0.0)

• Support of dial plan alarms

• Support of DHCP performance monitoring

• Support of ONU operational performance monitoring

• Supports additional VCD voice alarms

• Adds clarifications to FEC seconds definition.

[**ITU-T G.989.3 (revised) “40-Gigabit-capable passive optical networks (NG-PON2): Transmission convergence layer specification”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=14635) specifies the transmission convergence layer of 40 Gigabit-capable passive optical network (NG-PON2) systems providing optical access for residential, business, mobile backhaul and other applications. This Recommendation forms an integral part of the ITU-T G.989 series of Recommendations (ITU T G.989, ITU-T G.989.1 and ITU-T G.989.2) that, together with the ONU management and control interface (OMCI), Recommendation ITU-T G.988, specifies a coherent set of access transmission systems. The NG-PON2 system is also a member of the ITU-T G.9802 family.

[**ITU-T G.9802.1 “Wavelength division multiplexed passive optical networks (WDM PON): General requirements”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=14633) describes the general requirements for Wavelength Routed ODN based WDM PON. The general architecture and system level requirements, such as line rates, capacity in terms of channel count, OLT and ONU modularity, security, are given. The symmetric nominal line rate combinations of 25 Gbit/s and 10Gbit/s per wavelength channel are supported. The requirements for a range of relevant applications are described in terms of the needed interfaces, physical layer, operation, synchronization, resilience and protection options.

[**ITU-T G.9804.1 Amd.1 “Higher Speed Passive Optical Networks: Requirements - Amendment 1”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=14628) includes additional requirements for higher speed PON.

**ITU-T G.9804.2 “Higher Speed Passive Optical Networks: Common Transmission Convergence layer Specification” (under approval)** specifies the common transmission convergence (ComTC) layer of Higher Speed passive optical network (HSP) systems providing optical access for residential, business, mobile backhaul and other applications. This specification will define operation of HSP systems in a manner agnostic of transmission rates, number of operating wavelength channels, and signal modulation. It is intended to be applicable to systems implementing a subset of the specified range of features.

An HSP system enables protocol flexibility to support higher performance physical media dependent (PMD) interfaces without impacting the definition of the associated ComTC layer. An HSP system does not require an implementation to support all possible ComTC features. The intent is to stabilize the definition and behaviour of a ComTC layer independent of rate, number of wavelength channels, and signal modulation. Actual systems would be based on features chosen for implementation and available supporting technology. The ComTC layer is the protocol layer of the HSP system that is positioned between the PMD layer and service clients. It builds on the ITU T G.987.3, G.9807.1, and G.989.3 Recommendations, with modifications to support specific features, primarily rate flexibility, single and multiple wavelength operation, and signal modulation.

This Recommendation forms an integral part of the ITU-T G.hsp series of Recommendations (ITU T G.9804.1 and applicable PMD Recommendations) that, together with the ONU management and control interface (OMCI), Recommendation ITU-T G.988, specifies a set of access transmission systems.

[**ITU-T G.9804.3 “50-Gigabit-capable passive optical networks (50G-PON): Physical media dependent (PMD) layer specification”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=14714) describes a 50-Gigabit-capable passive optical network (50G-PON) system in an optical access network for residential, business, mobile backhaul and other applications. This system operates over a point-to-multipoint optical access infrastructure at the nominal line rate of 50 Gbit/s in the downstream direction. In the upstream direction, 12.5Gbit/s and 25 Gbit/s nominal line rates are defined currently, 50Gbit/s nominal line rate is for future study. This Recommendation contains the references, the common definitions, acronyms, abbreviations and the specifications of the physical media dependent layer of the 50G-PON system.

[**ITU-T G.9806 Amd.2 “Higher speed bidirectional, single fibre, point-to-point optical access system (HS-PtP) - Amendment 2”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=14629) adds support for 50 Gbit/s.

[**ITU-T G Suppl.71 “OLT Capabilities for supporting CO DBA”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?rec=14656) describes the passive optical network optical line termination or PON OLT capabilities needed for applying cooperative dynamic bandwidth assignment (CO DBA) both in a generic sense and for specific use cases. It explains the interactions of the optical line termination (OLT) with the external entity sending information for CO DBA, the way to interpret such information, and the needs for coordination on choosing values for configurable parameters. The specific use case described in this version of the Supplement is mobile fronthaul (MFH) over PON by using O-RAN's cooperative transport interface (CTI) for the interaction between the PON OLT and mobile distributed units (DUs).

I.1.3 Optical fibres

[**ITU-T L.100/L.10 (revised) “Optical fibre cables for duct and tunnel application”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=14631) describes characteristics, construction, test methods, and performance criteria of optical fibre cables installed by pulling method for duct and tunnel application. Note that Recommendation ITU-T L.10, Ed 3.0, was redesignated as L.100, Ed 3.0, in February 2016. First, in order that an optical fibre demonstrates sufficient performance, characteristics that a cable should possess are described. Then, the methods of examining whether a cable has the required characteristics are described. Therein, detailed performance criteria for a cable are recommended. Recommended technical requirements are detailed by reference to [IEC 60794-3-11], outdoor optical fibre cables for duct, directly buried, and lashed aerial applications. Changes and additions to these requirements suitable to the duct and tunnel cable application are recommended herein. Required conditions may differ from the installation environment. Therefore, instances where agreement on detailed conditions should be determined between customer and manufacturer are stated.

[**ITU-T L.201 (revised) “Performance requirements for passive optical nodes: Sealed closures for outdoor environments”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=14636) refers to passive optical nodes in outdoor environments. It deals with the design of the closure housing as well as the fibre organizer or fibre management system, taking into account mechanical and environmental characteristics as well as the characteristics of the optical fibre organizer. The following new elements are added in this revision:

– a new clause 5.3 on closure materials with detailed test requirements for UV-light exposure and fungus resistance of polymer materials and a material test requirement for the ageing of polymer materials by humidity;

– a new clause 5.5 on cable attachment and termination with recommendations for electrical grounding of metallic elements of the cables;

– a test program for the performance evaluation of sealed optical closures in ground level (OG) environment.

The following changes were made to harmonize the performance tests with [IEC 61753-1]:

− Sealing tests are done with 20 kPa overpressure for ground level (OG) and above ground (OA) closures;

− Pass-fail criteria of pressure loss during test are added to mechanical sealing tests for ground level (OG) and above ground (OA) closures;

− Reduced loads cable axial tension test for small diameter cables and microduct tubes;

− Reduced loads for cable axial compression test for small diameter cables;

− The duration of the cycles in cable torsion and cable bending test is added;

− Location for impact test added for rectangular shaped closures;

− Free fall test is removed (it is covered by a more reproduceable shock test);

− In the assembly and disassembly test the duration is reduced to 5 cycles;

− Resistance to solvents and contaminating fluids: added immersion in diesel with duration of 1 h and 24 h drying time and added immersion in petroleum jelly for 5 days. Kerosene is removed;

− Duration of the change of temperature is reduced to 12 cycles;

− Water immersion test at 1 m for 7 days for ground level (OG) closures.

[**Technical Paper LSTP-GLSR “Guide on the use of ITU-T L-series Recommendations related to optical technologies for outside plant”**](https://www.itu.int/pub/T-TUT-L-2021-GLR) provides information on the background, development and uses of L-series Recommendations prepared by Working Party 2 of ITU-T Study Group 15. These Recommendations are related to the design, construction, maintenance and operation of the optical fibre outside plant. The items covered are related to the following areas:

– optical fibre cable characteristics, evaluation and installation techniques;

– construction of optical infrastructure;

– network design;

– network maintenance and operation, including disaster management;

– passive optical components.

**I.1.4 Ultra-high-speed optical core network: OTN beyond 100G**

I.1.5 Optical transport network (OTN)

[**ITU-T G.703 Amd.1 “Physical/electrical characteristics of hierarchical digital interfaces - Amendment 1”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=14618) adds a new Annex B that specifies an interface with high-timing accuracy (1PPS). It also updates key references to refer to the latest versions.

[**ITU-T G.709/Y.1331 Amd.1 (revised) “Interfaces for the optical transport network (OTN) - Amendment 1”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=13743) defines the requirements for the optical transport network (OTN) interface signals of the optical transport network, in terms of:

– OTN hierarchy

– functionality of the overhead in support of multi-wavelength optical networks

– frame structures

– bit rates

– formats for mapping client signals.

Edition 6.1 of this Recommendation includes the addition of tables with GCC bit rates, enhancements to the description of OTUCn-M behaviour, addition of an appendix that describes the implications on fault management for the case that the OTSiG (de)modulator process and associated OTSiG-O|OCh-O\_TT function are located in adjacent equipment, and several typographical/editorial corrections.

[**ITU-T G.709.1/Y.1331.1 (2018) Amd.2 “Flexible OTN short-reach interfaces - Amendment 2”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=13520) restructures the definition of a FlexO-x frame and its overhead, adds payload type and reserved client specific overhead. In additional, FlexOsec encryption OH and functions are added.

[**ITU-T G.709.3/Y.1331.3 (revised) “Flexible OTN long-reach interfaces”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=14499) defines the flexible optical transport network (OTN), known as FlexO, long-reach interfaces that support bonding (i.e. grouping) of multiple of these interfaces such that one or more client signals (e.g. one or more OTUCn (n ≥ 1)) can be transferred via one or more optical tributary signals (OTSi) over one or more physical interfaces. The Recommendation specifies the frame structure for FlexO long reach interfaces using forward error correction codes with a higher coding gain than used in the FlexO short reach interfaces that are specified in Recommendation ITU-T G.709.1/Y.1331.1 and multiplexing of OTUCn client signals into the payload of a FlexO group.

Edition 2 contains the following extensions to Edition 1.1:

– Addition of 100G, 200G and 400G FlexO with OFEC (16, Annexes D, E, G, appendices III, IV, V, bibliography)

– Addition of 100G FlexO with concatenated FEC (15.4.1, 15.5.4)

– Addition of multiplexing of OTUCn client signals into the payload of a FlexO group (Annex F).

[**ITU-T G.798 Amd.3 “Characteristics of optical transport network hierarchy equipment functional blocks - Amendment 3”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=14520) contains text modifications and additions for:

– supporting 25 Gb/s and 50 Gb/s OTN interfaces.

– supporting 200 Gb/s and 400 Gb/s FlexO interfaces.

– supporting the adaptation of ODUkP to Ethernet Coding sublayer for 50 Gb/s Ethernet signals.

– supporting the adaptation of ODUkP to SDI/1.5G SDI signals.

– alignment with ITU-T G.709.1 and ITU-T G.709.3.

[**ITU-T G.876 "Management Requirement and Information Model for the optical media network"**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=14713) describes the management requirements and the information model for network elements (NEs) that contain optical media layer functions defined by the ITU-T equipment Recommendation based on the [ITU-T G.807] architecture, e.g., [ITU-T G.798]. The management requirements are based on [ITU-T G.7710] and the information model is based on [ITU-T G.7711] object classes. This version of G.876 provides only the optical media layer management requirements and information model for the optical transport network (OTN).

[**ITU-T G.807 Amd.1 “Generic functional architecture of the optical media layer - Amendment 1”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=14521) describes the generic functional architecture of the optical media network that supports the propagation of signals in the context of a transport network. This description is independent of the client CI that is being carried by a signal in the media network.

[**ITU-T G.872 Amd.1 “Architecture of the optical transport network - Amendment 1”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=14522) describes the functional architecture of the optical transport network (OTN) using the modelling methodology described in Recommendations ITU T G.800, ITU T G.805 and ITU T G.807. The OTN functionality is described from a network level viewpoint, taking into account, the characteristic information of clients of OTN, client/server layer associations, networking topology, layer network functionality and optical media network structure, which provide multiplexing, routing and supervision of digital clients. The digital layers of the OTN use the frame formats defined in ITU T G.709. The media portion of the network is described in terms of media constructs, media elements and optical signal maintenance entities.

I.1.6 Transport network control aspects

[**ITU-T G.7701 Amd.2 “Common control aspects - Amendment 2”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=14524) describes concepts that are common to both software defined networking (SDN) controller and automatically switched optical network (ASON) control approaches, including common aspects of the interaction between the control functions, management functions and transport resources.

[**ITU-T G.7703 “Architecture for the automatically switched optical network”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=14637) describes the reference architecture and requirements for the automatically switched optical network (ASON) as applicable to connection-oriented circuit or packet transport networks. This reference architecture is described in terms of the key functional components and the interactions between them and uses concepts from G.7701 that are common to both ASON and SDN control of transport networks as described in G.7702.

[**ITU-T G.7714.1/Y.1705.1 Amd.1 “Protocol for automatic discovery in transport networks - Amendment 1”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=14624): In clause 6.1 and Appendix VI.4.2 Case B, clarifies that the ODU TCM sublayer to be used for discovery is not restrict to TCM6 only.

[**ITU-T G.7719 "Management information model for MC components and functions"**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=14711) defines a protocol-neutral information model for managing the components that provide the functions of managing and/or controlling the transport network resources. The management requirements for such management and control (MC) components are specified in [ITU-T G.7718] for supporting the MC functions specified in [ITU-T G.7701], [ITU-T G.7702], and [ITU-T G.7703 (ex. G.8080)]. The information model defined in this Recommendation is specified using the Unified Modelling Language (UML).

[**ITU-T G.8052.1/Y.1346.1 “Transport OAM Management Information/Data Models for Ethernet Transport Network Element"**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=14558) specifies the management information model and data models for Ethernet Transport Network Element (NE) to support specific interface protocols and specific Management Control (MC) functions. The information model is interface protocol neutral and specified using the Unified Modelling Language (UML). The information model of this Recommendation is derived through pruning and refactoring from the Recommendation [ITU-T G.7711/Y.1702] core information model and Recommendation [ITU-T G.8052/Y.1346] foundation Ethernet Transport NE information model. The data models are interface protocol specific and translated from the information model with the assistance of automated translation tooling. The specific data models considered in this Recommendation include, but not limited to, YANG data models. The specific MC functions covered by this Recommendation are the ITU-T defined Ethernet Operation, Administration, and Maintenance (OAM) functions, with the set of op codes assigned to the ITU-T and the corresponding OAM Protocol Data Units (PDU) and behaviours being specified in Recommendation [ITU-T G.8013/Y.1731] and the equipment characteristics in [ITU-T G.8021/Y.1341]. These OAM functions complement the IEEE 802.1 defined Connectivity Fault Management (CFM) functions; and the YANG module defined in this Recommendation augments the IEEE 802.1Q CFM YANG module.

[**ITU-T G.8052.2/Y.1346.2 “Resilience Information/Data Models for Ethernet Transport Network Element”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=14632) specifies the resilience information models and data models for Ethernet Transport Network Element (NE) to support specific interface protocols and specific management and control (MC) functions.

The information models are interface protocol neutral and specified using the Unified Modelling Language (UML). The data models are interface protocol specific and translated from these information models. The specific data models considered in this Recommendation include, but are not limited to, YANG data models. The specific MC functions for resilience covered by this Recommendation include the [ITU-T G.8031] Ethernet Linear Protection and [ITU-T G.8032] Ethernet Ring Protection. The YANG data model in this version of the Recommendation covers the Ethernet Linear Protection mechanism defined in [ITU-T G.8031].

[**ITU-T G.8152.1/Y.1375.1 “AM Information/Data Models for MPLS-TP Network Element”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=14559) specifies the OAM information model and data models for MPLS-TP transport Network Element (NE) to support specific interface protocols and specific management and control functions. The information model is interface protocol neutral and derived from pruning and refactoring the G.7711/Y.1702 core information model and G.8152/Y.1375 foundation MPLS-TP NE information model. The data models are interface protocol specific and translated from the information model with the assistance of automated translation tool. The specific data models considered in this Recommendation include, but not limited to, YANG data models. The specific management and control functions covered by this Recommendation are the G.8113.1/Y.1372.1 specific OAM functions. The YANG modules of this Recommendation are aimed to be compatible with the relevant base generic YANG modules from the IETF for the G.8113.1/Y.1372.1 OAM functionality.

[**ITU-T G.8152.2/Y.1375.2 “Resilience Information/Data Models for MPLS-TP Network Element”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=14560) specifies the resilience management information model and data models for MPLS-TP Network Element (NE) as defined in [ITU-T G.8131] and [ITU-T G.8132]. The information model is interface protocol neutral and specified using the Unified Modelling Language (UML). The information model of this Recommendation is derived through pruning and refactoring from the Recommendation [ITU-T G.7711/Y.1702] core information model and Recommendation [ITU-T G.8152/Y.1375] foundation MPLS-TP NE information model. The data models are interface protocol specific and translated from the information model with the assistance of automated translation tooling. The specific data models considered in this Recommendation include, but not limited to, YANG data models.

[**ITU-T G Suppl. 72 "Modelling consideration for optical media networks”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?rec=14657) provides supplemental information to Recommendation [ITU-T G.876], “Management Requirement and Information Model for the optical media network” and [ITU-T G.7711] Generic protocol-neutral information model for transport resources. It provides various examples of the use of the Common Information Model (CIM), defined in Recommendation [ITU-T G.7711] to model optical media structures.

I.1.7 Mobile network transport

[**ITU-T G.8310 “Functional architecture for metro transport network”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=14516) describes the functional architecture of the metro transport network (MTN) using the modelling methodology described in [ITU T G.800], and [ITU T G.805]. MTN is primarily intended to support transport of D RAN and C RAN traffic. The MTN functionality is described from a network level viewpoint, taking into account the client characteristic information, client/server layer associations, networking topology, and layer network functionality that provide multiplexing, routing and supervision of the digital clients. MTN consists of two non recursive layers, the MTN Path layer, and the MTN Section layer. The MTN Path layer uses the MTN Section layer as its server layer. The MTN Path layer provides configurable connection-oriented connectivity. The server layer for the MTN section layer is provided by 50GBASE R, 100GBASE R, 200GBASE R, 400GBASE R Ethernet interfaces.

[**ITU-T G.8312 “Interfaces for a metro transport network”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=14517) describes a transport technology targeted for metro transport networks, including transport of distributed radio access network (D RAN) and centralized radio access network (C RAN) traffic. This technology leverages existing and emerging pluggable Ethernet modules and reuses FlexE implementation logic.

I.1.8 Ethernet over transport networks

[**ITU-T G.8010 Amd.3 “Architecture of Ethernet layer networks - Amendment 3”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=14625) describes the functional architecture of Ethernet networks using the modelling methodology described in ITU-T Recommendations G.805, G.809 and G.800. The Ethernet network functionality is described from a network level viewpoint, taking into account an Ethernet network layered structure, client characteristic information, client/server layer associations, networking topology, and layer network functionality providing Ethernet signal transmission, multiplexing, routing, supervision, performance assessment, and network survivability. The functional architecture of the server layer networks used by the Ethernet network is not within the scope of this Recommendation. Such architectures are described in other ITU-T Recommendations or IETF RFCs. This Recommendation is based on the Ethernet specifications in IEEE Standards 802.1Q-2018 and 802.3-2018, and developments of provider bridged networks. Furthermore, the architectural aspects of provider bridges currently being defined in IEEE P802.1ad task force are taken into account. This Recommendation defines the Ethernet maintenance entities, but the specific impact on the transport functions of connection monitoring in a connectionless layer network is not addressed. Ethernet network survivability is intended for inclusion in a future version. This Recommendation is the first of a series of Ethernet and Ethernet over Transport-related Recommendations. Other Recommendations in this series will address e.g., equipment, OAM, service, performance aspects.

I.1.9 Synchronization and timing

[**ITU-T G.8265.1 (revised) “Precision time protocol telecom profile for frequency synchronization”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=14727) describes the architecture and requirements for packet based frequency distribution in telecom networks. Examples of packet-based frequency distribution include the network time protocol (NTP), IEEE-1588-2008 and IEEE 1588-2019 are, briefly described here. Details necessary to utilize IEEE-1588-2008 and IEEE 588-2019 in a manner consistent with the architecture are defined in other Recommendations.

[**ITU-T G.8271.2/Y.1366.2 (revised) “Network limits for time synchronization in packet networks with partial timing support from the network”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=14638) specifies the maximum network limits of phase and time error that shall not be exceeded. It specifies the minimum equipment tolerance to phase and time error that shall be provided at the boundary of these packet networks at phase and time synchronization interfaces. It also outlines the minimum requirements for the synchronization function of network elements. Recommendation ITU-T G.8271.2/Y.1366.2 addresses the case of time and phase distribution across a network with packet based method with partial timing support to the protocol level from the network.

[**ITU-T G.8273.4/Y.1368.4 Amd.1 “Timing characteristics of telecom boundary clocks and telecom time slave clocks for use with partial timing support from the network - Amendment 1”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=14626) provides the following updates:

- Changes in clauses 2, 4, 7.3, 7.6.2, 9.1, Annex A, Annex B, and Bibliography

- Adds Appendix VI: PTP Noise Tolerance Testing for PTS and APTS Clocks.

[**ITU-T G.8275/Y.1369 Amd.1 “Architecture and requirements for packet-based time and phase distribution - Amendment 1”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=14627) incorporates reference to IEEE1588-2019 and includes Appendix IX: Considerations on the use of IEEE1588-2019.

[**ITU-T G.8275.1/Y.1369.1 Amd.2 (revised) “Precision time protocol telecom profile for phase/time synchronization with full timing support from the network: Amendment 2”**](https://www.itu.int/rec/T-REC-G.8275.1-202106-I%21Amd2) provides the following updates:

- Clarify the setting of frequencyTraceable for T-GM and T-BC

- Add details on the use of IEEE 1588-2019

- Clarification on some procedures

- Add new appendix “Considerations in an environment of more than two PTP ports on a single PTP communication path when using transparent clocks and multicast addressing”.

[**ITU-T G.8275.2/Y.1369.2 (2020) Amd.2 “Precision time protocol telecom profile for phase/time synchronization with partial timing support from the network - Amendment 2”**](https://www.itu.int/rec/T-REC-G.8275.2-202106-I%21Amd2) provides the following updates:

- Details added on the use of [IEEE 1588-2019]

- New profileVersion 1.2 and new profile Identifier added for [IEEE 1588-2019]

- New appendix added “Considerations on selecting time out values”

- New material added to clause 6.7.11 Packet timing signal fail.

- New member “defaultDS.sdoId” added to Table A.1 defaultDS data set member specifications

- New member “currentDS.meanDelay” added to Table A.2 currentDS data set member specifications

- New member “portDS.minorVersionNumber” added to Table A.5 portDS data set member specifications

- Parameters for “portDS.syncReceiptTimeout” and “portDS.delayRespReceiptTimeout” in Table A.5, which were “for further study”, were filled in.

I.1.10 Cable

[**ITU-T J.208 “Harmonization of Integrated Broadcast-Broadband DTV application control framework”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=14584)**:** Recommendations ITU-T J.207 and ITU-R BT.2075 provide guidance information for Integrated Broadcast-Broadband (IBB) service providers to select IBB systems for their use. In general, IBB systems comprise of various hardware and software components, and tailoring them for the specific IBB system leads to extensive development by manufacturers. On the other hand, in order to deploy the services in a wider area, IBB service providers need to develop their IBB applications for each IBB system if the operators or broadcasters on which the service providers intend to deploy their services use a different IBB system from the system on which the services are originally deployed. Thus, it is beneficial for both IBB service providers and manufacturers of IBB capable reception devices such as STBs to harmonize IBB systems. It should also be considered that the use of companion devices is already a part of IBB services. In addition, information on IBB application environment to implement an IBB application software for other IBB systems is useful to deploy the same service on different IBB systems. Based on the ideas above, this Recommendation is intended to define methods for harmonization of IBB systems and/or their application environment by identifying commonalities across IBB systems and maximizing portability of IBB applications.

[**ITU-T J.481 “Requirements of cable network for RF and IP secondary distribution of television programmes”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=14601): The cable television system requires to provide a set of high-quality multi-channel video programs using HFC or fibre optic cables. These are now mostly in RF format, but as cable television infrastructure migrates to support IP, the signal format should support both IP and RF formats. The use of IP format, as compared to the RF format, is expected to grow in the future. This Recommendation defines the requirements and architecture of a cable television system able to provide video services in both RF and IP formats. This Recommendation is expected to support cable operators to continue their current cable television business during the transition to IP and in mixed RF and IP environments.

[**ITU-T J.482 “Requirements of RF/IP switching system”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=14602) defines the requirements of a radio frequency (RF)/Internet protocol (I/IP) video switching system.

[**ITU-T J.1110 “Functional requirements specification for self-interference cancellation function of in-band full-duplex in HFC based network”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=14646)**:** Keywords such as ultra-high-resolution content delivery, end-to-end access service proliferation, high-speed transmission, and broadband transmission are becoming the basic requirements that network providers who are responsible for data transmission and receive should be accommodated. In particularly, as various IoT services, personal media, and cloud-based services become gradually common, there is a demand for the high data rate by subscribers. Cable networks are also undergoing various network evolution process to develop and apply technologies that satisfy the requirements of the service ecosystem. Currently, cable broadcasting networks have limited upstream frequency bands that can transmit data. In order to overcome these limitations and enable symmetric upstream and downstream transmission, we are developing in-band full-duplex (IFDX) transmission technology that enables simultaneous transmission and reception in the same band. For the efficiency performance of the IFDX, self-interference cancellation is one of the important factor, and this Recommendation is focused on the functional specification of the self-interference cancellation for IFDX transmission system in HFC based network.

[**ITU-T J.1301 “The specification of cloud-based converged media service to support IP and Broadcast Cable TV – Requirements”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=14585) describes functional requirement of the Cloud-Based Converged Media Service to support IP and Broadcast Cable TV. With the cloud-native technology development, cloud-based converged media service can be quickly deployed by cable television operators. This recommendation specifies functional requirements, architecture requirements, interface requirements and security requirements for the cloud-based converged media service to support IP and Broadcast Cable TV.

[**ITU-T J.1302 “The specification of cloud-based converged media service to support IP and Broadcast Cable TV - System Architecture”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=14647) defines the system architecture of the cloud-based converged media service to support IP and broadcast cable TV. With the cloud-native technology development, cloud-based converged media service can be quickly deployed by cable television operators. This Recommendation is Part 2 of a multi-part deliverable.

**ITU-T J.1631 "Functional requirements of E2E network platform for Cloud-VR services" (under approval)** describes functional requirement of the end-to-end (E2E) network platform to deliver 360°/Virtual Reality (VR) video services from the video cloud to the terminal devices. Cloud VR is a new cloud computing technology for VR services. With fast and stable transport networks, VR contents are stored and rendered in the cloud. Audio-visual contents are encoded, compressed, and transmitted to user terminals. This Recommendation specifies the network requirements of Cloud VR services.

[**ITU-T J.1611 “Functional requirements for Smart Home Gateway”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=14586): In a smart home solution, a smart home gateway is incorporated to connect various smart home appliances. In addition, an IoT-based connection management platform is required to enable various applications. These applicable solutions include home health, entertainment, security, and home automation, which promotes a safer, happier, and more comfortable and convenient lifestyle. This Recommendation aims to define the functional requirements for a smart home gateway from both hardware and software point of view to ensure secure interoperability among consumers, businesses and industries by delivering a standardized communications platform and allowing devices to communicate cross operating system, service provider, transport technology or ecosystem.

[**ITU-T J.1012 “Implementers' guide for Embedded common interface for exchangeable CA/DRM solutions; CA/DRM container, loader, interfaces, revocation”**](https://www.itu.int/rec/T-REC-J.Imp1012-202103-I) is an Implementers' Guide for ITU-T Recommendation of J.1012 Series. This revision contains all updates submitted up to and including those at Study Group 9 meeting in April 2021.

[**ITU-T Supplement 7 to ITU-T J-series Recommendations (revised) “Embedded common interface (ECI) for exchangeable CA/DRM solutions; Guidelines for the implementation of ECI”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=14286) serves as a guidance document, which contains performance parameters and values as well as use cases for the embedded common interface (ECI) for exchangeable CA/DRM solutions and complements ECI-related ITU-T Recommendations covering the ECI Ecosystem. This ITU-T Supplement is a transposition of ETSI Group Report ETSI GR ECI 004 and is a result of a collaboration between ITU-T SG9 and ETSI ISG ECI. A minor amendment was introduced with a new clause 6.4.

[**ITU-T Supplement 8 to ITU-T J-series Recommendations (revised) “Embedded common interface (ECI) for exchangeable CA/DRM solutions; Trust environment”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=14287) addresses details of a trust environment for the embedded common interface (ECI) for exchangeable conditional access (CA)/digital rights management (DRM) (CA/DRM) solutions and complements ECI-related ITU-T Recommendations covering the ECI Ecosystem. This ITU-T Supplement is a transposition of ETSI standard ETSI GS ECI 001-6 and is a result of a collaboration between ITU-T SG9 and ETSI ISG ECI..

[**ITU-T Supplement 11 to ITU-T J-series of Recommendations “Installing a digital TV service for cable networks and relating Recommendations”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?rec=14640): There have been several requests from developing countries, who are going to deploy fibre optics facilities and advanced digital transmission over Hybrid Fibre/Coaxial (HFC), to help them to introduce digital cable television services on their infrastructure. This Supplement will help their consideration of development of their system based on ITU-T Recommendations.

I.2.2 Smart ubiquitous networks, next-generation networks evolution, and future networks

[**ITU-T Q.4065 “Framework of model network for Tactile Internet testing”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=14617): According to ITU-T Technology Watch Report, the Tactile Internet (2014), the character of the Tactile Internet is defined as extremely low latency in combination with high availability, reliability and security. The existing telecommunication networks are mainly developed for distributing traditional voice, video and data services which parameters do not require extremely low latency. The services which are based on Tactile Internet will require establishing new principles of data processing in current and future networks. Currently, most of existing telecommunication networks do not allow operators to scale Tactile Internet services and provide it to most of their customers. In this regard, a model network may become an operator’s tool aimed at testing the Tactile Internet services before the implementation on the live telecommunication network.

This Recommendation describes the architecture, scenarios, and key networks metrics for establishing model network for testing Tactile Internet services. Particularly, the aim of a model network is to study the general principles of data generation for transmission of a tactile sensation through the telecommunication networks, including analysis of the network latency and other network performance parameters.

[**ITU-T Q.4067 “Signalling requirements for VNF lifecycle management under the testing environment”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=14610) specifies the process and signalling requirements for virtualized network function (VNF) lifecycle management under testing environment by architecturally adding the testing platform in the NFV framework. The signaling focuses on the interface between the VNF instantiation functional component in testing platform and NFVO functional component in MANO.

[**ITU-T Y.2343 “Scenarios and Capability Requirements of Programmable Log Analysis in Next Generation Networks”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=14611) specifies scenarios and capability requirements for programmable log analysis assurance for the next generation networks (NGN-PLA). This Recommendation first provides an overview of programmable log analysis in next generation networks. This Recommendation introduces the ecosystem for programmable log analysis in next generation networks, including roles and sub roles such as: log provider of NGN-PLA; log collection and forwarding service provider of NGN-PLA; log analysis service provider of NGN-PLA; log storage service provider of NGN-PLA; and log analysis service customer of NGN-PLA. This Recommendation then describes the requirements of programmable log analysis in next generation networks which are derived from the scenario use cases introduced in appendix I. Based on the overview and requirements, This Recommendation specifies programmable log analysis capabilities assurance for the next generation network.

[**ITU-T Y.2501 “Computing Power Network - framework and architecture”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=14768) describes the framework and architecture of computing power network. It is a new type of network that realizes the optimized resource allocation, by distributing computing, storage, network and other resource information of service nodes through network control plane. It combines network context and user requirements to provide the optimal distribution, association, transaction and scheduling of computing, storage and network resources.

[**ITU-T Y.2623 “Requirements and framework of Industrial Internet networking based on future packet based network evolution”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=14612) provides definitions and requirements of Industrial Internet networking in support of customized, collaborative, service-oriented and intelligent production/services. It also describes a framework of Industrial Internet networking for understanding significant relationships among the entities of factory internal network and factory external network.

I.2.3 IMT-2020/5G networks

[**ITU-T L.Suppl.43 to ITU-T L-series of Recommendations “Smart energy saving of 5G base station: Based on AI and other emerging technologies to forecast and optimize the management of 5G wireless network energy consumption”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=14762) explores how network energy saving technologies that have emerged since the 4G era, such as carrier shutdown, channel shutdown, symbol shutdown etc., can be leveraged to mitigate 5G energy consumption. It also analyses how enhanced technologies like deep sleep, symbol aggregation shutdown etc., have been developing in the 5G era. This report aims to detail these fundamentals. However, it is far away from being enough, a revolutionized energy saving solution should be taken into consideration. In response to the requirement of an intelligent and self-adaptive energy saving solution, artificial intelligence (AI) and big data technology are introduced to form a more precise energy saving strategy based on specific site traffic and other site-related conditions, thus improving the efficiency and reducing the manpower required. More details about AI-driven smart energy saving solution will be elaborated. This Supplement could help achieve the most energy-efficient network with good performance and lower operating expense (OPEX) for the mobile network operators (MNOs).

[**ITU-T Q.5023 “Protocol for managing intelligent network slicing with AI-assisted analysis in IMT-2020 network”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=14767) specifies protocol for managing intelligent network slicing with AI-assisted network analysis function in IMT-2020 networks. It describes architectural concept of intelligent network slicing APIs and management system, reference points among relevant functional elements, signalling flows over each reference point, and message formats with detail information.

[**ITU-T X.1811 “Security guidelines for applying quantum-safe algorithms in 5G systems”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=14454) identifies threats raised by quantum computing to fifth generation (5G) systems through assessing the security strength of currently used cryptographic algorithms. This Recommendation briefly reviewed quantum safe algorithms, including both symmetric and asymmetric types, and provides guidelines for applying quantum safe algorithms in 5G systems.

**ITU-T X.1812 “Security framework based on trust relationship for IMT-2020 ecosystem” (under approval)** identifies the stakeholders in the IMT-2020 ecosystem, analyses the trust relationships amongst them, identifies threats and clarifies security responsibilities for each stakeholder, defines the security boundaries between stakeholders, and establishes a security framework based on the trust relationships.

[**ITU-T Y.3077 “Framework for interworking of heterogeneous application domain connected objects through information-centric networking in IMT-2020”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=14775) specifies the framework, functions, and procedures for ICN device registration and discovery in distributed directory system functions collocated in gateways of each application domain and interworking of the directory system functions of various application domains by extending the ICN approach. It also specifies the communication procedure for interworking of devices within and across heterogeneous application domains for device management as well as accessing data and services provided by the devices.

[**ITU-T Y.3109 “QoS assurance-related requirements and framework for virtual reality delivery using mobile edge computing supported by IMT-2020**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=14396)**”** specifies Quality of Service (QoS) requirements and a framework for virtual reality delivery using mobile edge computing in IMT-2020. It first provides an introduction on virtual reality delivery using mobile edging computing supported by International Mobile Telecommunications (IMT) 2020 network. It then specifies QoS requirements and a framework. The classification of VR services and the detailed VR service factors that become a basis for identifying requirements are specified in Appendix I and II. The typical VR user cases and guidelines for deployments of VR services are described in Appendix III and VI.

[**ITU-T Y.3135 “Service scheduling for supporting FMC in IMT-2020 network”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=14596) specifies the requirements of service scheduling (e.g., traffic scheduling, access selection, etc.) for supporting Fixed-mobile Convergence (FMC) in IMT-2020 network. Based on the requirements of Fixed-mobile Convergence Service Scheduling (FMC-SS), it defines the functional framework and corresponding reference points. And it also provides service scheduling procedures and security considerations.

[**ITU-T Y.3157 “IMT-2020 network slice configuration”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=14597): The network slicing has been definitely regarded as a key technology to successfully deploy the IMT2020 network. The concept of network slicing and use cases in the IMT-2020 network are introduced in ITU-T Recommendation Y.3112. This Recommendation specifies network slice configuration in order to dynamically create and manage a network slice instance in the IMT-2020 network. Detailed topics are: how to create a network slice instance, how to provide QoS to the network slice, and how to associate application services of UE with the network slice instance.

[**ITU-T Y.3177 “Architectural framework of artificial intelligence-based network automation for resource and fault management in future networks including IMT-2020”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=14598) specifies an architectural framework of artificial intelligence (AI)-based network automation for resource management and fault management for the purpose of improving network efficiency and performance by continuously monitoring the network and promptly deciding about appropriate actions for resource adaptation and fault recovery with the help of AI including machine learning.

[**ITU-T Y.3178 “Functional framework of AI-based network service provisioning in future networks including IMT-2020”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=14613) specifies a functional framework of artificial intelligence (AI)-based network service provisioning in future networks, including IMT-2020. This Recommendation addresses the following aspects:

- Business role-based model for AI-based network service provisioning;

- High-level requirements for the roles and their interactions from an AI-based operational perspective;

- Functional components and their interactions for AI-based operations for network service provisioning.

[**ITU-T Y.3179 “Architectural framework for ML model serving in future networks including IMT-2020”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=14614) provides an architectural framework for ML model serving in future networks including IMT-2020, i.e., preparing and deploying ML models in different deployment environments to enable the application of ML model inference to ML underlay networks. The framework includes high-level requirements, and a high-level architecture description covering the definition of architectural components and reference points.

**ITU-T Y.4421 “Functional architecture for unmanned aerial vehicles and unmanned aerial vehicle controllers using IMT-2020 networks” (under approval):** The widely used civilian UAVs generate increasing requirements for communication and network capability, including seamless coverage, low latency, Gbps-level rate and high-accuracy positioning. The existing commercial products of civilian UAVs utilize direct radio link, which is limited by service distance and quality. Therefore IMT-2020 can be employed for UAV communication. The UAV requires simultaneous services with different characters, which is a brand-new type of user terminal to IMT-2020. Likewise, IMT-2020 is a novel communication network to the UAVs since it is originally designed for ground coverage. With the purpose of implementing the support of civilian UAV operations in IMT-2020 networks and improving quality of UAV application service, a set of functionalities is needed to bridge the gap for interoperation between UAS and IMT-2020 networks. This Recommendation provides a functional architecture for UAVs and UAV controllers using IMT-2020 networks and functionalities defined in 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.

I.2.4 Home networking

[**ITU-T G.9903 Amd.1 “Narrowband orthogonal frequency division multiplexing power line communication transceivers for G3-PLC networks - Amendment 1”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=14630) covers Cenelec A, Cenelec B, ARIB and FCC bandplans. It adds the G3-PLC Hybrid PLC & RF Profile as new Annex H.

[**ITU-T G.9961 (2018) Amd.3 “Unified high-speed wireline-based home networking transceivers - Data link layer specification Amendment 3”**](https://www.itu.int/rec/T-REC-G.9961-202104-I%21Amd3) includes enhancements to simplify routing mechanisms in tree topologies.

[**ITU-T G.9963 Amd.1 “Unified high-speed wireline-based home networking transceivers - Multiple input/multiple output specification: Amendment 1”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=14533) aligns this Recommendation with recommendations [ITU-T G.9960], [ITU-T G.9961] and [ITU-T G.9962].

**ITU-T G.9976 “Support UHD video service over G.hn” (under approval)** studies the specificities of transmission of UHD video service over G.hn. This document provides analysis on typical deployment of UHD video types in home network, typical scenarios (including typical topology, medium usage, support endpoints), and network requirements.

[**ITU-T G.9991 (2019) Amd.2 “High-speed indoor visible light communication transceiver - System architecture, physical layer and data link layer specification - Amendment 2”**](https://www.itu.int/rec/T-REC-G.9991-202104-I%21Amd2) includes a mechanism to support advanced inter-domain mobility through an external controller.

[**ITU-T Technical Report GSTP-FTTR “Use cases and requirements of fibre-to-the-room (FTTR)”**](https://www.itu.int/pub/T-TUT-HOME-2021-1)collects the use cases (including In-home Wi-Fi backhauling, Broadband deployment for dense apartment building, Network infrastructure for smart office, IoT support of smart home, Low latency service in home networks, Fibre deployment for FTTR for residential scenario, Network Slicing, East-West data transmission in home network), where FTTR can be used. Each use case is introduced by scenario of fibre-base network in home domain and analyses the new demand on network capability.

**Technical Paper ITU-T GSTP-HNAFS “Architecture, function and service of home network”** (under publication) provides an overview of various in-home services, general architecture and connection technologies of these networks.

I.2.5 Smart Grid

I.2.6 Software-defined networking

**ITU-T Y.3805 “Quantum Key Distribution Networks - Software Defined Networking Control” (under approval)** specifies the requirements, functional architecture, reference points, hierarchical SDN controller and overall operational procedures of SDN control.

[**ITU-T Y.3157 “IMT-2020 network slice configuration”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=14597): The network slicing has been definitely regarded as a key technology to successfully deploy the IMT2020 network. The concept of network slicing and use cases in the IMT-2020 network are introduced in ITU-T Recommendation Y.3112. This Recommendation specifies network slice configuration in order to dynamically create and manage a network slice instance in the IMT-2020 network. Detailed topics are: how to create a network slice instance, how to provide QoS to the network slice, and how to associate application services of UE with the network slice instance.

I.2.7 Cloud computing and data handling

**ITU-T X.1643 “Security guidelines for container in cloud computing environment” (under approval)** analyses security threats and challenges on container in cloud computing environment, and provides the security guidelines and reference framework for container in cloud.

**ITU-T Y.3526 “Cloud computing - Functional requirements of edge cloud management” (under approval)** provides requirements for edge cloud. It introduces the overview of edge cloud management including advantages of edge cloud management and relationship with global management in distributed cloud. It describes the edge cloud management local functions and mode. Additionally, this Recommendation provides edge cloud management functional requirements derived from use cases.

[**ITU-T Y.3527 “Cloud computing - End-to-end fault and performance management framework of network services in inter-cloud”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=14760) provides framework and functional requirements of end-to-end(E2E) fault and performance management of network services (NSs) in inter-cloud. The functional requirements are derived from the corresponding typical use cases. In particular, a predictive model for fault and performance issues detection and localisation is presented.

I.2.8 Big data

**ITU-T X.1752 “Security guidelines for big data infrastructure and platform” (under approval)** analyses security threats and challenges on big data infrastructure and platform, and provides the security guidelines and reference framework for big data infrastructure and platform.

**ITU-T Y.3606 “Big data - deep packet inspection mechanism for network big data” (under approval)** specifies mechanism of deep packet inspection applied in network big data context. This Recommendation specifies overview of big data processing procedure, relationship between deep packet inspection and big data related technologies, data classification mechanism using deep packet inspection for network big data, data pre-processing mechanism using deep packet inspection for network big data, coordination processing mechanism of deep packet inspection in network big data context and interfaces between deep packet inspection and the upper-layer big data related methods.

[**ITU-T Y.3653 “Big data driven networking - Functional architecture”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=14615) specifies functional architecture of big data driven networking. The afore-mentioned functional architecture includes the following aspects of functional architecture for big data driven networking: overview of functional architecture, functional architecture of big data plane, functional architecture of network plane, functional architecture of management plane and other aspects related to functional architecture.

I.2.9 Network Management

**ITU-T M.3365 “Requirements for QoE management of video in visual surveillance” (under approval)** introduces requirements for QoE management of video in visual surveillance, includes management of video resource, management of QoE indicators for video, configuration management of QoE evaluation activity, management of QoE evaluation record. This Recommendation provides the scenario of video quality evaluation system, which is a tool that implements the requirements given in this Recommendation. This Recommendation also gives examples of video quality evaluation record for reference.

[**ITU-T M.3080 “Framework of AI enhanced Telecom Operation and Management (AITOM)”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=14590) provides a framework of Artificial Intelligence (AI) enhanced Telecom Operation and Management (AITOM). It describes the functional framework of AITOM to support telecom operation management for efficiency improvement, quality assurance, cost management, and security assurance. It also describes AI pipelines that combines some components to enable AI based applications. This Recommendation also describes the relationship of functional framework of AITOM with smart operations, management and maintenance (SOMM) in M.3041. In the end, general requirements of security are described.

[**ITU-T Q.834.1 (2004) Amd.1 “ATM-PON requirements and managed entities for the network and network element views: Amendment 1 - Replace the reference to IEEE 802.1D by IEEE 802.1Q”**](https://www.itu.int/rec/T-REC-Q.834.1-202107-I%21Amd1): Since IEEE has withdrawn 802.1D and it is subsumed in 802.1Q, which covers all the functionality in 802.1D, in order to make this Recommendation up to date, Amendment 1 to Recommendation ITU-T Q.834.1 replaces the reference from IEEE 802.1D to 802.1Q (2018), and makes some corresponding changes for the related texts.

[**ITU-T Q.834.4 (2003) Amd.2 “A CORBA interface specification for Broadband Passive Optical Networks based on UML interface requirements: Amendment 2 - Replace the reference to IEEE 802.1D by IEEE 802.1Q”**](https://www.itu.int/rec/T-REC-Q.834.4-202107-I%21Amd2): Since IEEE has withdrawn 802.1D and it is subsumed in 802.1Q, which covers all the functionality in 802.1D, in order to make this Recommendation up to date, Amendment 2 to Recommendation ITU-T Q.834.4 (2003) adds the reference 802.1Q (2018), and makes some corresponding changes for the related texts.

[**ITU-T Q.838.1 (2004) Amd.1 “Requirements and analysis for the management interface of Ethernet Passive Optical Networks (EPON): Amendment 1 - Replace the reference to IEEE 802.1D by IEEE 802.1Q”**](https://www.itu.int/rec/T-REC-Q.838.1-202107-I%21Amd1)**:** Since IEEE has withdrawn 802.1D and it is subsumed in 802.1Q, which covers all the functionality in 802.1D, in order to make this Recommendation up to date, Amendment 1 to Recommendation ITU-T Q.834.1 replaces the reference from IEEE 802.1D to 802.1Q (2018), and makes some corresponding changes for the related texts.

[**ITU-T X.785 “Guidelines for defining REST-based managed objects and management interfaces”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=14745) defines a set of guidelines for managed object modelling and a management interface for REST-based network management. It is part of a framework for REST-based network management interfaces. It specifies how REST-based management interfaces should be defined. It covers the generic accessing methods of REST-based managed objects, accessing methods for specific MOs, information modelling in REST/HTTP and YAML/JSON schemas. Some HTTP requests/responses and YAML/JSON schemas are provided for defining some basic data types: generic managed object (MO) and generic MO accessing methods.

I.2.10 Artificial Intelligence (AI), Machine Learning (ML)

[**ITU-T F.748.12 “Deep learning software framework evaluation methodology”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=14681) provides the evaluation methodology for deep learning software framework. This can be used to guide relevant parties to test, select or evaluate a deep learning software framework. The evaluation methodology can reflect the current state of the training frameworks and inference frameworks by providing meaningful comparison dimensions.

[**ITU-T F.748.13 “Technical framework for shared machine learning system”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=14682) defines the roles, technical and security requirements of the shared machine learning system, and provides technical architectures, functional components and processing procedures of the shared machine learning system in the centralized and decentralized modes.

[**ITU-T F.749.13 “Framework and requirements for civilian unmanned aerial vehicle flight control using artificial intelligence”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=14684) provides the general framework and functional requirements for civilian unmanned aerial vehicle (CUAV) flight control using artificial intelligence, including the flight navigation control of a CUAV itself and the specific flight control according to the vertical industry application requirements. The regulations and supervision of civilian unmanned aerial vehicle flight are out of the scope of this Recommendation.

[**ITU-T F.749.14 “Requirements of coordination for civilian unmanned aerial vehicles”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=14685) specifies the requirements of coordination for civilian unmanned aerial vehicles (CUAVs), as well as the typical CUAV coordination scenarios in commercial or civilian application areas. The requirements of CUAV coordination includes the requirements of network connection among CUAVs, the requirements of data transmission among CUAVs, and the requirements of CUAV collaborative task execution.

[**ITU-T F.749.4 “Use cases and requirements for multimedia communication enabled vehicle systems using artificial intelligence”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=14683): Multimedia communication enabled vehicle systems using artificial intelligence is the ICT software platform in a vehicle to provide autonomous driving/assistance driving and in-vehicle infotainment applications based on AI technologies. This Recommendation describes the use cases and scenarios, high-layer architecture, service and network requirements, functional requirements and non-functional requirements for multimedia communication enabled vehicle systems using artificial intelligence.

[**ITU-T H.862.5 “Emotion enabled multimodal user interface based on artificial neural networks”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=14690) defines functional entities and architecture for emotion enabled multimodal user interface based on artificial neural network. In particular, the scope of this Recommendation includes architectural framework, functional entities and interfaces and application to multimodal emotion analysis. The proposed system architecture is for multimodal UI based on emotion analysis with some properties and illustrations and data with artificial neural network. The multimedia data for the input is composed of text, speech, and image. For the unimodal emotion analysis, these data are pre-processed in the corresponding module. For example, the text data is pre-processed by data augmentation, person attributes recognition, topic cluster recognition, document summarization, named entity recognition, sentence splitter, keyword cluster, and sentence to graph functions.

[**ITU-T L.Suppl.41 to ITU-T L-series of Recommendations “Requirements on energy efficiency measurement models and the role of AI and big data”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?rec=14761)**:** Several assessment models have been introduced to calculate the urban energy system and to demonstrate the variants that calibrate the local energy efficiency. This Supplement focuses on the impact of Artificial Intelligence (AI) and big data on energy efficiency. More specifically, this Supplement identifies a model that can calculate the energy efficiency in an urban space, from an AI and Big Data perspective. A literature analysis is performed with regard to the identification of existing energy efficiency assessment models under the lens of AI and big data and a special focus on the urban system, which results to an AI taxonomy for energy efficiency and to corresponding jobs (process steps) where big data are involved. This Supplement aims to unveil the requirements for energy efficiency assessment, and the features that affect the energy demand. It attempts to define a unified assessment model for energy efficient cities.

[**ITU-T L.Suppl.42 to ITU-T L-series of Recommendations “Guidelines on the Environmental Efficiency of Machine Learning Processes in Supply Chain Management”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?rec=14756) provides guidelines on the environmental efficiency of machine learning (ML) processes in supply chain management. This guidance document is intended to support machine learning researchers and operators to measure and improve the environmental efficiency of ML, and other emerging technologies (e.g. Blockchain, Big Data, 5G, …) use in supply chain management.

[**ITU-T L.Suppl.43 to ITU-T L-series of Recommendations “Smart energy saving of 5G base station: Based on AI and other emerging technologies to forecast and optimize the management of 5G wireless network energy consumption”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?rec=14762) explores how network energy saving technologies that have emerged since the 4G era, such as carrier shutdown, channel shutdown, symbol shutdown etc., can be leveraged to mitigate 5G energy consumption. It also analyses how enhanced technologies like deep sleep, symbol aggregation shutdown etc., have been developing in the 5G era. This report aims to detail these fundamentals. However, it is far away from being enough, a revolutionized energy saving solution should be taken into consideration. In response to the requirement of an intelligent and self-adaptive energy saving solution, artificial intelligence (AI) and big data technology are introduced to form a more precise energy saving strategy based on specific site traffic and other site-related conditions, thus improving the efficiency and reducing the manpower required. More details about AI-driven smart energy saving solution will be elaborated. This Supplement could help achieve the most energy-efficient network with good performance and lower operating expense (OPEX) for the mobile network operators (MNOs).

[**ITU-T M.3080 “Framework of AI enhanced Telecom Operation and Management (AITOM)”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=14590) provides a framework of Artificial Intelligence (AI) enhanced Telecom Operation and Management (AITOM). It describes the functional framework of AITOM to support telecom operation management for efficiency improvement, quality assurance, cost management, and security assurance. It also describes AI pipelines that combines some components to enable AI based applications. This Recommendation also describes the relationship of functional framework of AITOM with smart operations, management and maintenance (SOMM) in M.3041. In the end, general requirements of security are described.

[**ITU-T Q.5023 “Protocol for managing intelligent network slicing with AI-assisted analysis in IMT-2020 network”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=14767)specifies protocol for managing intelligent network slicing with AI-assisted network analysis function in IMT-2020 networks. It describes architectural concept of intelligent network slicing APIs and management system, reference points among relevant functional elements, signalling flows over each reference point, and message formats with detail information.

[**ITU-T Y.3177 “Architectural framework of artificial intelligence-based network automation for resource and fault management in future networks including IMT-2020”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=14598) specifies an architectural framework of artificial intelligence (AI)-based network automation for resource management and fault management for the purpose of improving network efficiency and performance by continuously monitoring the network and promptly deciding about appropriate actions for resource adaptation and fault recovery with the help of AI including machine learning.

**ITU-T Y.3178 “Functional framework of AI-based network service provisioning in future networks including IMT-2020” (under approval)** specifies a functional framework of artificial intelligence (AI)-based network service provisioning in future networks, including IMT-2020. This Recommendation addresses the following aspects:

- Business role-based model for AI-based network service provisioning;

- High-level requirements for the roles and their interactions from an AI-based operational perspective;

- Functional components and their interactions for AI-based operations for network service provisioning.

[**ITU-T Y.3179 “Architectural framework for ML model serving in future networks including IMT-2020”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=14614) provides an architectural framework for ML model serving in future networks including IMT-2020, i.e., preparing and deploying ML models in different deployment environments to enable the application of ML model inference to ML underlay networks. The framework includes high-level requirements, and a high-level architecture description covering the definition of architectural components and reference points.

[**ITU-T Supplement 70 to ITU-T Y.3800-series “Quantum Key Distribution Networks - Applications of Machine Learning”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?rec=14757) presents the applications of machine learning (ML) in the quantum layer, the key management layer and the management and control layers of QKDN including the use case background and analysis.

[**ITU-T F.Sup4 “Overview of convergence of artificial intelligence and blockchain”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?rec=14651)**:** Artificial intelligence (AI) is one of core essential driving forces of a new round of industrial reform, which can affect promoting the upgrading of the traditional industries. Blockchain presents opportunities for disruptive innovations, which enables global businesses to transact with less friction and more trust. AI and blockchain promote and influence each other, and the convergence of them could bring big driving forces for industries a great creativity across a wide range of business applications in many fields. There are many benefits and challenges to combine AI and blockchain together. This Supplement focuses on the research on the convergence of AI and blockchain, specifically analyzes the mutual promotion between AI and blockchain, and provides a technical reference for the application of AI and blockchain. Besides, this Supplement also provides application analysis of the convergence of AI and blockchain.

I.3.1 Video and image coding

[**ITU-T H.222.0 | ISO/IEC FDIS 13818-1 (8th Ed.) “Information technology - Generic coding of moving pictures and associated audio information: Systems”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=14658) includes three amendments and a corrigendum of the previous 7th edition. By the first amendment, which is already published, support for the carriage of data encoded according to ISO/IEC 21122-1, also known as JPEG XS, has been added. The corrigendum, which has also been published, corrects a conflicting stream\_type value for Timeline and External Media Information (TEMI) streams. Further amendments will not be published separately, but only integrated in this new edition. These amendments define how VVC (ISO/IEC 23090-3) is carried over MPEG-2 systems, how EVC (ISO/IEC 23094-1) is carried over MPEG-2 systems, how compatible profile sets for MPEG-H 3D Audio (ISO/IEC 23008-3) are signalled in MPEG-2 systems, and extend the semantics for the ISO 639 language descriptor.

[**ITU-T H.264 (V14) (revised) “Advanced video coding for generic audiovisual services”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=14659) adds additional SEI messages for annotated regions and shutter interval information, and also includes corrections to various minor defects in the prior content of the Specification. This Recommendation was developed jointly with ISO/IEC JTC 1, Information technology, Subcommittee SC 29, Coding of audio, picture, multimedia and hypermedia information, and Rec. ITU-T H.264 is maintained as technically aligned twin text with ISO/IEC 14496-10. The technical changes in this edition were developed in a joint collaborative team with SC 29 in technical alignment with a not-yet-published edition of ISO/IEC 14496-10.

[**ITU-T H.265 (V8) | International Standard ISO/IEC 23008-2 “High efficiency video coding”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=14660) represents an evolution of the existing video coding Recommendations (ITU-T H.261, ITU-T H.262, ITU-T H.263 and ITU-T H.264) and was developed in response to the growing need for higher compression of moving pictures for various applications such as Internet streaming, communication, videoconferencing, digital storage media and television broadcasting. It is also designed to enable the use of the coded video representation in a flexible manner for a wide variety of network environments. The use of this Recommendation | International Standard allows motion video to be manipulated as a form of computer data and to be stored on various storage media, transmitted and received over existing and future networks and distributed on existing and future broadcasting channels. This revision adds an additional SEI message for shutter interval information, and also includes corrections to various minor defects in the prior content of the Recommendation. This Recommendation was developed jointly with ISO/IEC JTC 1, Information technology, Subcommittee SC 29, Coding of audio, picture, multimedia and hypermedia information, and Rec. ITU-T H.265 is maintained as technically aligned twin text with ISO/IEC 23008-2. The technical changes in this edition were developed in a joint collaborative team with SC 29 in technical alignment with a not-yet-published edition of ISO/IEC 23008-2.

[**ITU-T H.273 (V2) (revised) “Coding-independent code points for video signal type identification”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=14661) defines various code points and fields that establish properties of a video (or still image) representation and are independent of the compression encoding and bit rate. These properties may describe the appropriate interpretation of decoded data or may, similarly, describe the characteristics of such a signal before the signals compressed by an encoder that is suitable for compressing such an input signal. This revision includes the addition of a figure to illustrate example usage, a code point for chroma sampling grid alignment indication for the 4:2:0 colour format, correction of the range of values specification for sample aspect ratio indication, correction of the equations for the ICTCP colour representation for the hybrid-log-gamma (HLG) transfer function specified in Rec. ITU-T BT.2100 2, and correction of the equations for the transfer function for the sYCC colour representation specified in IEC 61966-2-1. This Recommendation was developed jointly with ISO/IEC JTC 1, Information technology, Subcommittee SC 29, Coding of audio, picture, multimedia and hypermedia information, and Rec. ITU-T H.273 is maintained as technically aligned twin text with ISO/IEC 23091-2. The technical changes in this edition were developed in a joint collaborative team with SC 29 in technical alignment with a not-yet-published edition of ISO/IEC 23091-2.

[**ITU-T H-series Supplement 19 (revised) “Usage of video signal type code points”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?rec=14652) provides information on video signal property description code points and their combinations that are widely used in production and video content workflows. This H-series supplement was developed collaboratively with ISO/IEC JTC 1/SC 29 and corresponds with ISO/IEC TR 23091-4 as a technically aligned twin text.

[**ITU-T T.801 (V2) | ISO/IEC 15444-2 “Information technology – JPEG 2000 image coding system – Extensions”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=14666) extends the capabilities of Rec. ITU-T T.800 | ISO/IEC 15444-1 ("JPEG 2000"). The 1st edition of this Recommendation | International Standard dates to 2004. It has since then been supplemented by amendments and corrigenda, several of its normative references have been obsoleted, and industry practices have evolved. This 2nd edition addresses these shortcomings without modifying its scope. This Recommendation was developed jointly with ISO/IEC JTC 1/SC 29/WG 1 (JPEG), and is common text with ISO/IEC 15444-2. This second edition cancels and replaces the first edition, which has been technically revised. The main changes compared to the previous edition are as follows:

– Annex N ("JPX file format extended metadata definition and syntax") is deprecated;

– the Registration Authority specified in M.7, which was never created or used, is cancelled;

– signalling for HTJ2K codestreams, as specified in Rec. ITU-T T.814 | ISO/IEC 15444-15, is added;

– the RLT marker segment is added;

– references have been revised to their currently in-force editions;

– signalling for codestreams that conform to ISO/IEC 21122-1 is added;

– parameterized colourspace is added to the Colour Specification box;

– outstanding amendments and corrigenda are consolidated; and

– the definition of the CAP marker segment is removed, having been moved to Rec. ITU-T T.800 (2019) | ISO/IEC 15444-1:2019.

[**ITU-T T.803 (2021) Ed.2 | ISO/IEC 15444-4:2021 Ed.3 (revised) “Information technology – JPEG 2000 image coding system: Conformance testing”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=14667) provides the framework, concepts, and methodology for testing and the criteria to be achieved to claim compliance to either or both of Rec. ITU-T T.800 | ISO/IEC 15444-1 and Rec. ITU-T T.814 | ISO/IEC 15444-15 (HTJ2K). This Recommendation was developed jointly with ISO/IEC JTC 1/SC 29/WG 1 (JPEG), and corresponds as common text with ISO/IEC 15444-4. This third edition cancels and replaces the second edition, which has been technically revised. The main changes compared to the previous edition are as follows:

– Annex B is augmented with procedures for testing HTJ2K decoder compliance.

– Annex C is augmented to describe test codestreams for HTJ2K decoders and allowable errors for compliant HTJ2K decoders.

– Annex E is augmented with decoder implementation compliance statements that are suitable for HTJ2K decoders.

– Annex F is augmented to include features specific to HTJ2K codestreams.

– Annex G is augmented with JPH file format reader compliant testing procedures.

This Recommendation | International Standard contains a normative electronic attachment with the codestreams used in the application of the procedures described herein and available at [https://www.itu.int/ifa/t/2017/sg16/exchange/wp3/q06/Refs/T.803-15444-4-Ed3\_Codestreams.zip].

[**ITU-T T.804 | ISO/IEC 15444-5 (Ed.3) (revised) “Information technology – JPEG 2000 image coding system: Reference software”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=14668) provides three independently created software reference implementations of Rec. ITU-T T.800 | ISO/IEC 15444-1, in order to assist implementers of Rec. ITU-T T.800 | ISO/IEC 15444-1 in testing and understanding its content. The packages are JASPER, JJ2000 and OPENJPEG. This Recommendation | International Standard also provides an independently created software reference implementation of Rec. ITU-T T.814 | ISO/IEC 15444-15, which specifies a high-throughput (HT) block coding algorithm that can be used in place of the block coding algorithm of Rec. ITU-T T.800 | ISO/IEC 15444-1, in order to assist implementers of Rec. ITU-T T.814 | ISO/IEC 15444-15 in testing and understanding its content. The package is TT. This Recommendation | International Standard additionally provides an independently created software reference implementation for parsing of a JP2 file format specified in Rec. ITU-T T.800 | ISO/IEC 15444-1 and a JPH file format specified in Rec. ITU-T T.814 | ISO/IEC 15444-15, The package is Codestream-parser. This Recommendation | International Standard does not define any additional part of the JPEG 2000 image coding system. Each version of the J2K reference software contains source code, which can be compiled to provide the following functionality:

– Transcoding from selected, widely available image formats into a JPEG 2000 codestream.

– Transcoding from selected, widely available image formats into the JP2 file format.

– Selection of a wide range of JPEG 2000 encoding options (as documented in each reference software).

– Decoding from a JPEG 2000 codestream to a range of selected widely available image formats.

– Processing of a JP2 file to extract a JPEG 2000 codestream for decoding and conversion to a range of selected widely available image formats.

– The ability to extract metadata from a JP2 file, including the contents of the Image Header box and the colour space.

– The decoding of JP2 files that use the three-component matrix-based form of the restricted ICC method for the specification of colour space and the conversion of the decoded image data to the sRGB colour space for display, including limited upsampling of all decoded components to the same resolution.

– The decoding of JP2 files that use the monochrome form of the restricted ICC method for the specification of colour space and the conversion of the decoded image data to the sRGB based greyscale space as defined within the JP2 file format.

– The decoding of JP2 files that use the sYCC colour space and the conversion of the decoded image data to the sRGB colour space for display, including upsampling of all decoded components to the same resolution.

– Some additional tools to help with evaluation and testing.

The TT HTJ2K reference software contains source code, which can be compiled to provide the following functionality:

– Decoding from a HTJ2K codestream to a range of selected widely available image formats.

The codestream-parser reference software contains source code, which can provide the following functionality:

– Parsing of JP2 file format;

– Parsing of JPH file format.

The reference software is intended for use as a testing and validation tool for other implementations of JPEG 2000, and to help in the understanding of Rec. ITU-T T.800 | ISO/IEC 15444-1 and Rec. ITU-T T.814 | ISO/IEC 15444-15. This Recommendation was developed jointly with ISO/IEC JTC 1/SC 29/WG 1 (JPEG), and corresponds as common text with ISO/IEC 15444-5. This third edition cancels and replaces the second edition, which has been technically revised. The main changes compared to the previous edition are as follows:

– A software reference implementation of Rec. ITU-T T.814 | ISO/IEC 15444-15 is added.

– A software reference implementation for parsing of a JP2 and a JPH files is added.

[**ITU-T T.815 | ISO/IEC 15444-16 (Ed.2) (revise) “Information technology – JPEG 2000 image coding system – Encapsulation of JPEG 2000 images into ISO/IEC 23008-12”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=14669)**:** To simplify the use of the JPEG 2000 family of image formats (Rec. ITU-T T.8xx series | ISO/IEC 15444) in applications that use the ISO base media file format, this Recommendation | International Standard specifies the encapsulation of these image formats in the framework defined in ISO/IEC 23008-12. ISO/IEC 23008-12 specifies a framework for the interchange of images and image sequences using tools defined in the ISO base media file format (ISO/IEC 14496-12), which is in wide use worldwide. This framework is defined independently of the formats of the images and image sequences, allowing a wide range of such formats to be used in combination with ISO/IEC 23008 12. This Recommendation was developed jointly with ISO/IEC JTC 1/SC 29/WG 1 (JPEG), and corresponds as common text with ISO/IEC 15444-16. This second edition cancels and replaces the first edition, which has been technically revised. The main changes compared to the previous edition are as follows:

– the encapsulation of Rec. ITU-T T.802 | ISO/IEC 15444-3 image sequences is deprecated, and replaced by the encapsulation of Rec. ITU-T T.800 | ISO/IEC 15444-1 image sequences;

– adds support for quality and resolution layers;

– the syntax and semantics of the JPEG 2000 header item property are clarified; and reader conformance requirements are removed.

[**ITU-T T.873 | ISO/IEC 10918-7 (Ed.2) (revised) “Information technology – Digital compression and coding of continuous-tone still images: Reference software”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=14693): To simplify the use of the JPEG format (Rec. ITU-T T.81 | ISO/IEC 10918-1), this Recommendation | International Standard provides two reference software implementations that provide guidance how to implement Rec. ITU-T T.81 | ISO/IEC 10918-1. Rec. ITU-T T.81 | ISO/IEC 10918-1 is in wide use worldwide. It provides a compressed representation of continuous tone digital images. This Recommendation was developed jointly with ISO/IEC JTC 1/SC 29/WG 1 (JPEG), and corresponds as common text with ISO/IEC 10918-7. This second edition cancels and replaces the second edition, which has been technically revised. The main change in this second edition are updates of Reference Software A to release 1.59, and of Reference Software B to release 2.0.x, fixing multiple minor technical defects that have been identified over the last years. No other functional changes have been made.

I.3.2 Intelligent, interoperable visual surveillance systems

[**ITU-T F.743.12 “Requirements for edge computing in video surveillance”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=14680) defines the requirements for edge computing in video surveillance. Edge computing is a distributed computing paradigm aimed at providing various computing services at the edge of the network, and it brings computation and data storage closer to the data source or the location where it is needed, to improve response time and save bandwidth. By using the edge computing technology, the video surveillance system can perform the intelligent video analysis and store data near the network premises units. And the edge computing platform provides the management capabilities of the edge resources and functional components to the video surveillance system. It can improve the video processing efficiency and quality of services, and reduce the infrastructure cost of the video surveillance system. This Recommendation describes the application scenarios and requirements for the edge computing in the video surveillance system.

**ITU-T M.3365 “Requirements for QoE management of video in visual surveillance” (under approval)** introduces requirements for QoE management of video in visual surveillance, includes management of video resource, management of QoE indicators for video, configuration management of QoE evaluation activity, management of QoE evaluation record. This Recommendation provides the scenario of video quality evaluation system, which is a tool that implements the requirements given in this Recommendation. This Recommendation also gives examples of video quality evaluation record for reference.

[**ITU-T T.627 “Test specification for video surveillance networking”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=14692) describes the test specification for video surveillance networking. Recommendation ITU-T H.626V2 defines the architecture of the video surveillance system, and Recommendation ITU-T H.627V2 defines the signalling and protocols for a video surveillance system. This Recommendation specifies the test objects, test classification and test tools, test environment, and test requirements, which can be used for testing against ITU-T H.626V2 and ITU T H.627V2.

I.3.3 IPTV and digital signage

[**ITU-T Technical Paper HSTP.ACC-UC "Use cases for inclusive media access services"**](https://www.itu.int/pub/publications.aspx?lang=en&parent=T-TUT-FSTP-2021-ACC.UC) describes use cases for multimedia accessible system. This Technical paper describes an experiment of IPTV services with accessibility functions based on ITU-T Recommendation about accessibility profiles for IPTV systems.

I.3.4 Immersive live experience

I.3.5 Standards to assess quality of video communications and applications

I.3.6 New services and applications

[**ITU-T F.735.2 “Architecture and protocols for software-defined cameras”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=14678)**:** As defined in Recommendation [ITU-T F.735.1], software-defined cameras can provide the basic hardware service APIs and the common software service APIs for the application developer, and these APIs are called "service-oriented interfaces". This Recommendation aims specifies these service-oriented interfaces for the software-defined camera to guide the different developers to implement algorithms according to these APIs, and guide camera manufacturers to design more open and flexible cameras to achieve algorithms easily upgrade and camera hardware resource maximum utilization. This Recommendation specifies an architecture and interface protocols for the software-defined cameras, including the functional architecture of software-defined camera system, service-oriented interface message protocol structure, and service-oriented interface protocols.

[**ITU-T F.740.2 “Requirements and reference framework for digital representation of cultural relics/artworks using augmented reality”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=14679) describes the requirements, application scenarios and reference framework for digital representation of cultural relics/artworks using augmented reality, which is used in augmented reality cultural service system (ARCSS). This Recommendation describes the AR digital presentation requirements, cultural connotation interpretation requirements, cultural venue tour guide requirements, platform management requirements and performance requirements for ARCSS. This Recommendation contains a reference framework of ARCSS with AR cloud creation platform, AR cloud management platform and mobile devices. Procedures of augmented reality cultural services provided in this Recommendation include AR content creation procedure, AR service management procedure and AR content display procedure. This Recommendation is intended as a reference for AR providers and cultural venue managers when they build a digital representation system or an application of cultural relics/artworks using augmented reality.

[**ITU-T H.644.4 “Architecture for mobile/multi-access edge computing enabled content delivery networks”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=14686) specifies a functional architecture for mobile/multi-access edge computing (MEC) enabled content delivery network (MEC-CDN). The functions and functional blocks within this functional architecture and the related reference points are specified in this Recommendation for matching the requirements in [ITU-T F.743.10]. Particularly, this Recommendation also provides the deployment of virtualized CDN service and the interworking between virtualized CDN functionalities and MEC management system, within a MEC-CDN ecosystem. In addition, a containerized solution of MEC-CDN is given in this Recommendation, followed by the basic information flows. This Recommendation is intended to provide the references for the virtualized CDN solution providers to extend their CDN service to the network edges. As described in this Recommendation, it is beneficial for multimedia content providers to dispatch their content closer to the end-user then before by adopting a lightweight MEC-CDN solution, which can also meet the lower latency and higher bandwidth requirements.

[**ITU-T H.862.4 “Framework for ICT olfactory function test systems”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=14689) defines framework for ICT olfactory function test system. The scope of this Recommendation lies in the framework for ICT-based olfactory function test system involving the human factors. Specifically, the human's condition is checked for the olfactory examination, and the scent is sprayed accordingly to the human, and the human's reaction is collected and analysed to define the process of confirming the olfactory function. The proposed system is for four types of olfactory function tests: odour identification, olfactory threshold, odour recognition, and olfactory discrimination. Components and detailed actions according to the procedure of the corresponding tests are defined.

[**ITU-T Y.2246 “Smart Farming Education Service based on u-learning environment”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=14758) provides a reference architecture and service requirements for Smart Farming Education. It focuses on the farming education service about farming knowledge which includes the farming technology, farming skills, farmer’s experiences and know how, etc. The information related to farming knowledge will reflect current activities, farming products and from the experience of farmers in the field. The core component of the automation process is the creation of a data store which will be a repository for this information. The farming sector will benefit immensely from the implementation of farming data in a farming contents repository which will serve as the knowledge base for the automation process. It discusses how this service may be used to develop a knowledge base intended to benefit those involved in the farming sector.

I.4.1 Internet of Things and Smart City

[**ITU-T X.1368 “Secure firmware/software update for Internet of things devices”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=14445) specifies: 1) basic models and procedures for securely updating firmware/software (FW/SW) of Internet of things (IoT) devices; and 2) requirements and capabilities for updating IoT FW. A common secure update procedure is specified with general requirements. This procedure allows common IoT SW/FW updates to be securely implemented among stakeholders in the IoT environment, such as IoT device developers and IoT system/service providers. This Recommendation focuses on updating FW, but it is applicable to updating any other SW of IoT devices.

**ITU-T X.1369 “Security requirements for IoT service platform” (under approval)** provides the security requirements for IoT service platform. It assesses the security threats and challenges to IoT business service platform and describes security measures that could mitigate the security threats and challenges.

[**ITU-T Y.4122 “Requirements and capability framework of edge computing-enabled gateway in the IoT”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=14735): The gateway is an important component of IoT systems, enabling IoT devices to connect to communication network. Edge computing technologies can benefit the IoT providing computation, storage, networking and intelligence in proximity to IoT devices. Compared with the common gateway [ITU-T Y.4101], the edge computing-enabled gateway in the IoT (EC-enabled IoT gateway) has additional capabilities supporting service layer interworking, and application layer interworking among IoT devices, IoT platforms and IoT application servers. In addition, the EC-enabled IoT gateway supports data transmission capabilities for IoT applications sensitive to time, latency, jitter and packet loss. Based on common requirements and capabilities of a gateway for Internet of things applications [ITU-T Y.4101] and IoT requirements for support of edge computing [ITU-T Y.4208], 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.4419 “Requirements and Capability Framework of Smart Utility Metering (SUM)”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=14736) 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. Compared with other types of utility metering, SUM intends to improve utility management and meet the emerging requirements from advanced applications, such as intelligent utility scheduling.

[**ITU-T Y.4420 “Framework of IoT based monitoring and management for Lift”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=14737): Lifts need to interact with applications through communication networks to provide different kinds of services to end users. In many cases, lifts cannot connect to communication networks directly. Therefore, gateways support the interconnection of such lifts with communication networks. Correspondingly, various lift companies applied their own data models and protocols. For this reason, interoperability problems have occurred. This Recommendation describes a framework of IoT based monitoring and management for lift with a protocol and data model to solve these problems.

**ITU-T Y.4421 “Functional architecture for unmanned aerial vehicles and unmanned aerial vehicle controllers using IMT-2020 networks” (under approval):** The widely used civilian UAVs generate increasing requirements for communication and network capability, including seamless coverage, low latency, Gbps-level rate and high-accuracy positioning. The existing commercial products of civilian UAVs utilize direct radio link, which is limited by service distance and quality. Therefore IMT-2020 can be employed for UAV communication. The UAV requires simultaneous services with different characters, which is a brand-new type of user terminal to IMT-2020. Likewise, IMT-2020 is a novel communication network to the UAVs since it is originally designed for ground coverage. With the purpose of implementing the support of civilian UAV operations in IMT-2020 networks and improving quality of UAV application service, a set of functionalities is needed to bridge the gap for interoperation between UAS and IMT-2020 networks. This Recommendation provides a functional architecture for UAVs and UAV controllers using IMT-2020 networks and functionalities defined in 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.4471 “Functional architecture of network-based driving assistance for autonomous vehicles”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=14423) 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 transaction of distributed ledger assigned to IoT resources”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=14578)**:** An object identifier (OID) is an identifier to name an object in a hierarchically assigned namespace. In the Internet of Things (IoT), thousands of IoT resources will be intricately provided as fusion types of various services. For the thousands of IoT resources, object identifiers (OIDs) can provide a resolution framework with unlimited scalability. On the other hand, IoT resources need to secure their data, so the distributed ledger technology (DLT) can guarantee its integrity. In consequence, convergence of DLT and OIDs provide a good solution for identifying secured data of IoT resources. Therefore, this Recommendation specifies a resolution framework for the transactions of a distributed ledger assigned to IoT resources. This Recommendation describes the concepts, functional requirements, architecture and procedures of an OID-based resolution framework by using DLT.

**ITU-T Y.4809 “Unified IoT Identifiers for Intelligent Transport Systems” (under approval)** defines field formats for identifying road signs/signals and identifies specific values for identifiers of such signs/signals.

[**ITU-T Y.Suppl.58 (revised) “Internet of things and smart cities and communities standards roadmap”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?rec=14729) 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 (USNs).

[**ITU-T Y.Suppl.68 “Framework for Internet of Things ecosystem Master Plan”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?rec=14731)**:** A healthy Internet of Things (IoT) ecosystem can be an effective tool to increase industry competitiveness and citizens’ wellbeing. There are many areas where IoT can be deployed, such as agriculture, health care, consumer goods, industry, and education, and it may not be practical or possible to act on all verticals at the same time. An IoT Master Plan is intended to focus resources on priority verticals or areas with the aim of producing more effective results taking into consideration the country’s particular environment (e.g., challenges and opportunities) and priorities. When defining this Master Plan, it is important to consider international benchmarking and have a holistic methodology that considers the country’s priorities but also takes into account the potential demand, supply and development capacity when selecting priority vertical domains. It’s also crucial to engage relevant stakeholders, including those from various verticals, industries, government, academia and civil society throughout the process, from plan development to execution, to support effective deployment.

Therefore, this Supplement 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.

[**ITU-T Y.Suppl.69 “Web based data model for IoT and smart city systems and services”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?rec=14732)**:** Data models play a critical role in data, applications, systems, and businesses across various industries as they provide the definition and format of data to support data, computer systems, and related businesses. Supplement Y.Suppl.68 to ITU-T Y-series Recommendations 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.

I.4.4 Connected vehicles, automated driving and intelligent transport systems

**ITU-T F.749.4 “Use cases and requirements for multimedia communication enabled vehicle systems using artificial intelligence” (under approval)**: Multimedia communication enabled vehicle systems using artificial intelligence is the ICT software platform in a vehicle to provide autonomous driving/assistance driving and in-vehicle infotainment applications based on AI technologies. This Recommendation describes the use cases and scenarios, high-layer architecture, service and network requirements, functional requirements and non-functional requirements for multimedia communication enabled vehicle systems using artificial intelligence.

**ITU-T F.749.5 (H.VDS-UC) | ISO 23239-1 “Vehicle domain service: General information and use case definitions” (under approval):** Connected vehicles are expected to expand and become even more popular in different markets worldwide. A variety of technologies are being developed and discussed for many applications. This document provides a basic definition of vehicle domain service and supplementary information on detailed concepts, as well as definitions of the typical and supplementary use cases being used to define the specification of applications. Detailed specifications of communications and applications are provided in other documents in the series, and they are not provided in this Recommendation.

[**ITU-T X.1376 “Security-related misbehaviour detection mechanism using big data for connected vehicles”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=14448): As connectivity of vehicles increases, the number of vulnerabilities is rising due to the development of complex technology. These vulnerabilities bring more threats to connected vehicles. Analysis of a large amount of automotive data is very useful for assessing security of connected vehicles. Recommendation X.1376 describes a security-related misbehaviour detection mechanism for connected vehicles to help stakeholders to utilize automotive data to improve vehicle security.

[**ITU-T Technical Paper FSTP.SS-OTA “Standardization survey for over-the-air updating in vehicle"**](https://www.itu.int/pub/publications.aspx?lang=en&parent=T-TUT-ITS-2021-OTA) is prepared for the purpose of grasping the examination situation in various organizations of the technology to remotely update the software of the on-board system in the automobile with the communication function as a connected car. Based on this survey/study, we clarify the importance of quickly and accurately grasping the movement in various organizations around the world including the United Nations and accelerating the activities for practical application. The study in this field will be continued and accelerated in the future, so it is extremely important for whole world not only for Japan to continue to participate, contribute, and contribute to various activities including the subject of this study in the context of international competition and cooperation.

[**ITU-T Y.4471 “Functional architecture of network-based driving assistance”**](https://www.itu.int/rec/T-REC-Y.4471-202105-I/en)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 Appendices I and II, respectively. To improve the driving of autonomous vehicles, coordination between vehicles and infrastructures needs 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 for autonomous vehicles.

[**ITU-T F.749.3 ”Use cases and requirements for the vehicular multimedia networks”**](https://www.itu.int/rec/T-REC-F.749.3-202008-I/en) specifies use cases and requirements for vehicular multimedia networks (VMN), including an overview, connectivity, intelligent human machine interfaces (HMI) for the vehicle multimedia system (VMS), privacy considerations, content rights protection in a converged network environment, copyright and rights management support for content delivery, security, safety, and definitions of vehicular multimedia configurations.

[**ITU-T F.749.4 “Use cases and requirements for multimedia communication enabled vehicle systems using artificial intelligence”**](https://www.itu.int/rec/T-REC-F.749.4-202106-P) describes the use cases and scenarios, high-layer architecture, service and network requirements, functional requirements and non-functional requirements for multimedia communication enabled vehicle systems using artificial intelligence.

I.4.5 Connected health: e-Health

[**ITU-T H.830.17 “Conformance of ITU-T H.810 personal health system: Services interface Part 17: Personal Health Device Observation Upload (POU) Sender”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=14687) includes an electronic attachment with the protocol implementation conformance statements (PICSs) and the protocol implementation extra information for testing (PIXIT) required for the implementation of Annex A.

[**ITU-T H.830.18 “Conformance of ITU-T H.810 personal health system: Services interface Part 18: Personal Health Device Observation Upload (POU) Receiver”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=14688) includes an electronic attachment with the protocol implementation conformance statements (PICSs) and the protocol implementation extra information for testing (PIXIT) required for the implementation of Annex A.

**ITU-T X.1080.2 “Biology to machine protocol” (under approval)** allows a medical centre remotely to monitor a patient and to retrieve information from that patient. It defines a general protocol for exchange of biometric information from a patient facility to a medical expert facility. It also allows the medical expert facility to control the sensors and other devices at the patient facility and to establish the environment for a monitor session at the patient facility. It also defines a versatile and open-ended information model that allows any type of medical and non-medical information to be transferred.
Recommendation ITU-T X.1080.2 is a biosignal communication protocol between computing devices and biological systems. X.b2m protocol is based upon an aggregation of the interactions between a computing device and the biological system. Biometric interactions are described using the telebiometric multimodal model as defined by [ITU-T X.1081], which is a three-layer model combining the sciences, sensors, and metric layers. X.b2m is a horizontal market protocol designed to be used for all IoT biometric metric applications i.e. aerospace, medical, automotive, industrial and consumer markets. For the case of clinical medical trials, ITU-T X.1080.2 protocol enriches the application with a versatile and open-ended information model filled with interaction descriptions thereby ensuring an accurate comparison of measurement processes.

[**ITU-T Technical Paper HSTP.CONF-H870 "Testing of personal audio systems for compliance with ITU-T H.870"**](https://www.itu.int/pub/publications.aspx?lang=en&parent=T-TUT-EHT-2021-CONFH870) describes the testing of the compliance of various personal audio systems/devices to the essential/mandatory and optional features of H.870.

I.5.1 New security standards

**ITU-T F.747.10 “Requirements of distributed ledger systems (DLS) for secure human factor services” (Determined; Decision planned January 2022)** provides general requirements and functional capabilities for distributed ledger systems (DLS) for secure human factor services. This Recommendation describes the requirements for the secure human factor distributed ledger service model, which can solve conflicting goals of privacy protection and big personal human factor data utilization. This Recommendation also includes the functional capabilities for human factor distributed ledger shared nodes to perform machine learning without decryption on encrypted human factor data. However, the computational burden of machine learning for encrypted data may be excessive. To solve this problem, this human factor distributed ledger service model provides procedures for allowing the use of two or more encryption key pairs and notifying the key type. In addition, this Recommendation involves the integrity maintaining requirements for secure human factor services to maintain a safe distributed ledger and checked from the beginning to distribute personal human factor information. Therefore, the application of distributed ledger system in the distribution of personal secure human factor information can ensure transparent tracking from the distribution process to the final use path.

**ITU-T X.501 Amd.1 “Information Technology - Open systems Interconnection - The Directory – Models: Draft amendment 1 (to Rec. ITU-T X.501(2019) | ISO/IEC 9594-2:2020): Miscellaneous enhancements” (under approval)** has successfully gone through the enquiry state at ISO/IEC and ISO/IEC does not anymore accept any technical comments. ITU-T SG 17 members have been part of the ISO/IEC ballot process and have had ample opportunities in the past to influence the technical content.

**ITU-T X.1011 “Guidelines for continuous protection of service access process” (under approval)**: To prevent the unauthorized access to information and the abuse of ICT resources is fundamental to the cybersecurity. An extensive effort had been made towards the standardization of identity and access management. However, the access environment is continuously changing and traditional mechanisms could not deal with the challenges of current security threats. Firstly, traditional data center infrastructure is moving to the cloud, consequently the perimeter security device for traditional data center is not applicable to cloud data center. Secondly, internal threats are becoming more and more serious, e.g. authorized user trying to perform dangerous operations caused by negligence, and internal users being attacked by social engineering which may lead to impersonation risk. Thirdly, the status of the device or resource may become insecure during access process, e.g. OS or software in device and resource platform getting compromised by exploitation of misconfigure, and access request being intercepted, etc. Service access process is the process during the interval between a subject initiating access requests and receiving responses from a service, which may include a variety of above mentioned security threats. In order to deal with above challenges, it is crucial to continuously analyse related security status, keep the rationality of access activity, protect the security of access process and prevent unsecure access. Referring to the zero trust in current security industry, this recommendation is to define a reference framework for keeping continuous protection of service access process.

**ITU-T X.672 | ISO/IEC 29168-1 (revised) “Information technology – Open systems interconnection – Object identifier resolution system” (under approval)** specifies the object identifier (OID) resolution system (ORS). This enables (arbitrary) information to be associated with any ORS-supported OID node (of the international object identifier tree defined in Rec. ITU-T X.660 | ISO/IEC 9834-1). This associated information is identified by an application specification that may have a requirement for instances of that application (running on any computer system) to obtain the associated information by an ORS search, using an ASN.1 OID-IRI value to identify the node. Currently defined application information for a node includes the canonical form of an international object identifier, child node information, registration information about the owner of the node, a reference to an ASN.1 module identified by the node, information supporting tag-based applications, and information supporting cybersecurity.

**ITU-T X.1047 “Security requirements and architecture for network slice orchestration and management” (under approval)** establishes security requirements and architecture for network slice management and orchestration, as well as automatic creation of end-to-end (E2E) network slices with customized security capabilities, to deploy full-scale E2E network slicing for consumer, business and government segments.
Mobile communication has enriched people’s lives. In the future, there is no reason to doubt that mobile communication will continue to develop, reaching industries such as automotive, manufacturing, logistics and energy, as well as sectors such as finance and healthcare that do not currently fully exploit the potential of mobile services. However, various applications have different requirements. Some applications may require ultra-reliable communication, whereas others may require ultra-high-bandwidth communication or extremely low latency. So, network slicing has been introduced to offer a different mix of capabilities to meet all these diverse requirements at the same time.
With network slicing, various types of users or customers can enjoy connectivity and data processing tailored to their specific requirements (e.g., data speed, quality, latency, reliability, security and pricing model) that adhere to a service level agreement agreed with consumers, enterprises and vertical industries. However, there are some challenges for implementing full-scale E2E network slicing deployments for consumer, business and government segments, e.g., E2E precision slicing, network slice reliability, network slice scalability and network slice lifecycle management. One of the most important challenges is network slice security, which is beginning to receive attention from academia and industry.
[b-3GPP TR 33.811] studies security for network slice management exposure interface and integrity protection of the network slice subnet template, and [3GPP TS 33.501] specifies management security for network slices (e.g., authentication, authorization, integrity protection, and confidentiality protection for the interface between the management service producer and the management service consumer) based on the study. [b-3GPP TR 33.813] studies network slice specific authentication and authorization, data confidentiality and integrity, user identification privacy and inter-slice security isolation.

**ITU-T X.1054 (revised) “Information security, cybersecurity and privacy protection - Governance of information security” (under publication):** Information security is a key issue for organizations, amplified by rapid advances in attack methodologies and technologies, and corresponding increased regulatory pressures. The failure of an organization’s information security controls can have many adverse impacts on an organization and its interested parties including but not limited to the undermining of trust. Governance of information security is the use of resources to ensure effective implementation of information security, and provides assurance that:

• directives concerning information security will be followed; and

• the governing body will receive reliable and relevant reporting about information security related activities.

This assists the governing body to make decisions concerning the strategic objectives for the organization by providing information about information security that may affect these objectives. It also ensures that information security strategy aligns with the overall objectives of the entity.

Managers and others working in organizations need to understand:

• the governance requirements that affect their work; and

• how to meet governance requirements that require them to take action.

[**ITU-T X.1060 “Framework for the creation and operation of a Cyber Defence Centre”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=14721) defines Cyber Defence Centre as the entity that plays a central role in an organization to address cybersecurity risks. The three processes of build, management and evaluation that CDC should practically implement are described as a framework, and the services that the organization should have in order to implement more specific cybersecurity measures are also provided.

[**ITU-T X.1061 “Cyber insurance acquisition guideline”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=14733) provides the understanding of cyber insurance coverage and the requirements of cyber security risks assessments, selection of insurer, assessment by the insurer, and evaluation of insurer for organisations that adopt cyber insurance as a risk treatment option to manage the impact of a cybersecurity incident.

**ITU-T X.1080.2 “Biology to machine protocol” (under approval)** allows a medical centre remotely to monitor a patient and to retrieve information from that patient. It defines a general protocol for exchange of biometric information from a patient facility to a medical expert facility. It also allows the medical expert facility to control the sensors and other devices at the patient facility and to establish the environment for a monitor session at the patient facility. It also defines a versatile and open-ended information model that allows any type of medical and non-medical information to be transferred.
Recommendation ITU-T X.1080.2 is a biosignal communication protocol between computing devices and biological systems. X.b2m protocol is based upon an aggregation of the interactions between a computing device and the biological system. Biometric interactions are described using the telebiometric multimodal model as defined by [ITU-T X.1081], which is a three-layer model combining the sciences, sensors, and metric layers. X.b2m is a horizontal market protocol designed to be used for all IoT biometric metric applications i.e. aerospace, medical, automotive, industrial and consumer markets. For the case of clinical medical trials, ITU-T X.1080.2 protocol enriches the application with a versatile and open-ended information model filled with interaction descriptions thereby ensuring an accurate comparison of measurement processes.

[**ITU-T X.1217 “Guidelines for applying threat intelligence in telecommunication network operation”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=14443)**:** Threat intelligence from a telecommunication operator’s point of view is a collection of organized, analysed, and refined information about potential and current attacks that may threaten an organization. This information can also include attackers’ motivations, intentions, characteristics, and methods, along with their modus operandi or techniques, tactics, and procedures. In network and information security area, the occurrence of large-scale and unexpected cybersecurity incidents has triggered the urgent need for threat intelligence. Threat intelligence can help an organization to reduce risk and improve its overall security. A unified taxonomy, grammar, and presentation of threat intelligence has been defined so that threat intelligence can be shared between different organizations. This Recommendation specifies guidelines for applying threat intelligence in telecommunication network operation after an overview analysis.

[**ITU-T X.1233 “Guidelines for countering spam over instant messaging”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=14773) specifies guidelines for instant messaging (IM) service providers and users to counter spam over instant messaging (SPIM) and to reduce propagation of SPIM in cyberspace and improve IM user's experience. This Recommendation analyses scenarios of generating SPIM in instant messaging, specifies technical measures and mechanisms to counter SPIM for IM service providers, as well as recommendations to counter SPIM for IM users.

**ITU-T X.1234 “Guideline for countering multimedia messaging service (MMS) spam” (under approval)** to provide some guidelines for countering MMS spam. It analyses typical scenarios, characteristics and recognition methods of MMS spam, and provides a technical framework, work flows and some key technologies of MMS spam recognition, to help MMS providers and MMS users to counter spam.

**ITU-T X.1235 “Technologies in countering website spoofing for telecommunication organizations” (under approval):** Website spoofing is a major threat for telecommunication organizations, especially operators. It is recommended for telecommunication operators to adopt counter website spoofing technologies to protect their customers and guard their reputation and revenue. This Recommendation analyses the main measures to spoof a website and recommends technologies to identify spoofed websites, which can be regarded as guidelines for protecting websites from being spoofed for telecommunication organizations. This Recommendation could be referred to by other organizations to counter website spoofing.

**ITU-T X.1246 Amd.1 “Technologies involved in countering voice spam in telecommunication organizations” (under approval)** introduces the feedback mechanism from the client, receiving possible spam call (with voice, sms, or mms) to its operator. It provides technical requirements for telecommunication management systems and/or client support services to receive notifications of income spam calls, voice or messages (sms/mms). Scenarios of interactive interaction of clients with operators/service providers of telephone communication networks about incoming spam calls and the necessary technical measures to maintain such interaction are presented. Such interaction is based on making a call to the anti-spam number provided by the telecom operator in advance by the recipient of the spam call immediately after it is completed.

**ITU-T X.1247 Amd.1 “Technical framework for countering mobile messaging spam” (under approval)** introduces the feedback mechanism from the client, receiving possible spam call (with voice, sms, or mms) to its operator. It provides technical requirements for telecommunication management systems and/or client support services to receive notifications of income spam calls, voice or messages (sms/mms). Scenarios of interactive interaction of clients with operators/service providers of telephone communication networks about incoming spam calls and the necessary technical measures to maintain such interaction are presented. Such interaction is based on making a call to the anti-spam number provided by the telecom operator in advance by the recipient of the spam call immediately after it is completed.

[**ITU-T X.1252 (revised) “Baseline identity management terms and definitions”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=14642) provides definitions of key terms used in identity management (IdM). The terms are drawn from many sources but all are believed to be in common use in IdM work. This Recommendation is not intended to be a huge compendium of IdM-related terms. Instead, the terms defined here are limited to those considered to constitute a baseline list of the most important and commonly-used IdM-specific terms. This Recommendation includes Annex A that explains the rationale for some of these key terms. One of the main objectives of this Recommendation is to promote a common understanding of these terms among the groups currently developing (or planning to develop) IdM-related standards. The definitions are constructed so that, as far as possible, they are independent of implementations or specific context and, therefore, should be suitable as baseline definitions for any IdM work. It is acknowledged that, in some instances and contexts, greater detail may be required for a particular term, in which case, elaboration of the baseline definition may be considered.

**ITU-T X.1333 “Security guidelines for use of remote access tools in Internet-connected control systems” (under approval):** Remote access tools (RATs) are widely used on control systems for monitoring, control and maintenance to reduce maintenance costs and minimize the response time in the event of a malfunction. RATs provide the ability to manipulate control systems remotely, but at the same time, an insecure configuration of RATs and vulnerabilities in RATs could significantly increase the attack surface of control systems. The most serious problem is an interface to access a control system from the external networks that could make attackers access to control system from the Internet.
The Recommendation is intended to give a whole picture to employ RATs securely for monitoring, control and maintenance. In this Recommendation, threats to network configuration due to the use of RATs will be identified and security guidelines will also be provided to adapt secure configuration and security measures for the use of RATs in Internet-connected control systems. Providing well-organized security controls on the use of RATs would be helpful for digital service providers operating control systems to reduce the attack surface and the threats from external networks. Moreover, it would be beneficial to align the security levels between developed and developing countries, since this is not a local problem, but a global problem.

**ITU-T X.1369 “Security requirements for IoT service platform” (under approval)** provides the security requirements for IoT service platform. It assesses the security threats and challenges to IoT business service platform and describes security measures that could mitigate the security threats and challenges.

[**ITU-T X.1406 “Security threats to online voting system using distributed ledger technology”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=14734) identifies security threats to online voting system using DLT based on telecommunication/ICT infrastructure. It proposes a reference model of online voting system using DLT based on telecommunication/ICT infrastructure and analyzes security threats in online voting process described in the models.

**ITU-T X.1407 “Security requirements for digital integrity proofing service based on distributed ledger technology” (under approval)** specifies the security threats and requirements in digital integrity proofing based on distributed ledger technology (DLT). The original proof protected is stored in the off-chain. The hashed data values are stored in the on-chain. This Recommendation analyses the security threats to the digital integrity proofing services based on DLT, namely, proof registration and proof provenance. This Recommendation describes the security requirements that could address these security threats.

**ITU-T X.1408 “Security threats and requirements for data access and sharing based on distributed ledger technology” (under approval)**: A distributed ledger technology (DLT) is defined as a shared digital ledger, or a continually updated list of all transactions. Data is accessed by a data controller (organization) and is possibly transferred to a data processor (organization) that will be responsible for processing the data on behalf of the data controller. A data controller should determine the purpose and the manner in which the data will be processed according to the constraints imposed by the data policy set by organizations. In this context, there is a necessity of trusted and transparent solution to enhance
1) traceability of the data being accessed by data controllers and data processors directly or indirectly;
2) verifiability that if the data was accessed, used, and transferred without violating the data policy set by organizations, and;
3) changeability of data status in case of modification of data policy or any other cases.
An important aspect of this solution is to enable trust and transparency on data accountability and provenance & usage tracking. It should offer transparent and controlled data access, sharing and processing, so that unauthorized users or untrusted servers cannot process data without the authorization.
This Recommendation focuses on the solution which provides a way to improve traceability of data, verifiability of data, and changeability of data status. The solution is suitable for implementation using private distributed ledger technology where data is accessed and shared less frequently. This Recommendation provides security threats and requirements for data access and sharing based on the distributed ledger technology (DLT). It describes the framework and models for data access and sharing based on DLT. It identifies entities and their roles for data access and sharing based on DLT. It also identifies security threats. In addition, security requirements that address these security threats are described.

**ITU-T X.1453 “Security threats and requirements for video management systems” (under approval)**: A video management system (VMS) is an important feature of physical security systems such as home and building security systems. Current and emerging VMS approaches incorporate more intelligence into their design, including video analytics and the ability to interface with access control systems. Basically, a VMS receives video from cameras and allows someone to view that video either live or recorded. As a VMS is networked, it is fully exposed to various vulnerabilities such as those faced by internet web services. Therefore, as a VMS is not inherently secure, it is easily becoming the main targets of cyberattacks. This Recommendation proposes to analyze the security threats inherent to VMSs running on an IP network. This Recommendation also proposes security requirements to counteract the identified security threats.

**ITU-T X.1470 “Security guidelines of web-based online customer service” (under approval)**: Web-based online customer service is an important service for operators. It contains the user's important data and provides critical operational functions of the user’s services. It is the operators’ responsibility to provide security to web-based online customer service. This Recommendation analyses the security threats of web-based online customer service to operators in view of three aspects: network security, system security, service security, and provides security guidelines of web-based online customer service and the test procedures to the security measures. This Recommendation can help the operators to ensure their web-based online customer services’ security and protect the users’ benefits.

**ITU-T X.1643 “Security guidelines for container in cloud computing environment” (under approval)** analyses security threats and challenges on container in cloud computing environment, and provides the security guidelines and reference framework for container in cloud.

**ITU-T X.1712 “Security requirements and designs for quantum key distribution networks - key management” (under approval)** specifies security threats and security requirements for key management in quantum key distribution networks (QKDNs), and then it specifies security measures of key management to meet the security requirements. This Recommendation provides support for design, implementation, and operation of key management in QKDN with approved security.

**ITU-T X.1752 “Security guidelines for big data infrastructure and platform” (under approval)** analyses security threats and challenges on big data infrastructure and platform, and provides the security guidelines and reference framework for big data infrastructure and platform.

**ITU-T X.1770 “Technical guidelines for secure multi-party computation” (under approval)**: Multi-party computation (MPC) could build trust and security in data collaboration and big data analysis related areas. Data has become one of the most important assets in ICT area. MPC plays a very important role in balancing data usage and data protection. The purpose of this recommendation is to provide technical guidelines for MPC, and provide technical and standard basis for ICT stakeholders to use MPC to protect data in data collaboration and big data analysis scenarios. It also describes applications on what MPC can be used for and how to use MPC. It can provide reference for ICT stakeholders to develop MPC applications. The content of the Recommendation includes:
• Technical framework of MPC: defines the elements in MPC and the work flow between the elements;
• Security levels of MPC protocols: analyse and define the security model and threshold;
• Applications of MPC: describe different use cases of MPC, including scene description, processes, etc.
Based on this recommendation, standards for MPC applications in different fields can be defined.

[**ITU-T X.1811 “Security guidelines for applying quantum-safe algorithms in 5G systems”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=14454) identifies threats raised by quantum computing to fifth generation (5G) systems through assessing the security strength of currently used cryptographic algorithms. This Recommendation briefly reviewed quantum safe algorithms, including both symmetric and asymmetric types, and provides guidelines for applying quantum safe algorithms in 5G systems.

**ITU-T X.1812 “Security framework based on trust relationship for IMT-2020 ecosystem” (under approval)** identifies the stakeholders in the IMT-2020 ecosystem, analyses the trust relationships amongst them, identifies threats and clarifies security responsibilities for each stakeholder, defines the security boundaries between stakeholders, and establishes a security framework based on the trust relationships.

[**ITU-T X.Suppl.36 “Supplement to ITU-T X.1051:ISO/IEC 27011 (2016) Information technology – Security techniques – Code of practice for information security controls based on ISO/IEC 27002 for telecommunications organizations: Critical security controls for telecommunications organizations information and network security management”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=14809) describes the Critical Security Controls (CSC) to supplement the implementation of ITU-T X.1051. The CSC are a prioritised set of actions that collectively form a defense-in-depth set of best practices that mitigate the most common attacks as part of the organization’s information and network security management. These controls are developed by a community of IT experts who apply their first-hand experience as cyber defenders to create a globally accepted security best practices and to include multiple sectors including retail, manufacturing, healthcare, education, government, defense and others.

[**ITU-T Technical Report TR-USM “Unified Security Model (USM) - a neutral integrated system approach to Cybersecurity”**](https://www.itu.int/pub/publications.aspx?lang=en&parent=T-TUT-TRANSFO.INNO-2020-2)offers a one stop place, as a live document, to regroup all the related work conducted.

**ITU-T Technical Report TR.XAASL “Framework for security standardization for virtualized service” (under publication)** is a document for discussion regarding the development of standards considerations, requirements and frameworks for virtualized services. These services are often known by the words “as a Service” – as in, Network as a Service. The architecture for these virtualized services comes from work done in ITU-T Study Group 13. However, this discussion is around the security implications and considerations for those services which is within the mandate of ITU-T Study Group 17.

I.5.2 Quantum key distribution networks

**ITU-T X.1712 “Security requirements and designs for quantum key distribution networks - key management” (under approval)** specifies security threats and security requirements for key management in quantum key distribution networks (QKDNs), and then it specifies security measures of key management to meet the security requirements. This Recommendation provides support for design, implementation, and operation of key management in QKDN with approved security.

**ITU-T Y.3805 “Quantum Key Distribution Networks - Software Defined Networking Control” (under approval)** specifies the requirements, functional architecture, reference points, hierarchical SDN controller and overall operational procedures of SDN control.

**ITU-T Y.3806 “Quantum key distribution networks - Requirements for QoS assurance” (under approval)** specifies the high-level and functional requirements of QoS assurance for quantum key distribution networks (QKDN). The functional requirements include QoS planning, QoS monitoring, QoS optimization, QoS provisioning, QoS protection and recovery.

[**ITU-T Supplement 70 to ITU-T Y.3800-series “Quantum Key Distribution Networks - Applications of Machine Learning”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?rec=14757) presents the applications of machine learning (ML) in the quantum layer, the key management layer and the management and control layers of QKDN including the use case background and analysis.

I.5.3 Trust

**ITU-T X.1770 “Technical guidelines for secure multi-party computation” (under approval)**: Multi-party computation (MPC) could build trust and security in data collaboration and big data analysis related areas. Data has become one of the most important assets in ICT area. MPC plays a very important role in balancing data usage and data protection. The purpose of this recommendation is to provide technical guidelines for MPC, and provide technical and standard basis for ICT stakeholders to use MPC to protect data in data collaboration and big data analysis scenarios. It also describes applications on what MPC can be used for and how to use MPC. It can provide reference for ICT stakeholders to develop MPC applications. The content of the Recommendation includes:
• Technical framework of MPC: defines the elements in MPC and the work flow between the elements;
• Security levels of MPC protocols: analyse and define the security model and threshold;
• Applications of MPC: describe different use cases of MPC, including scene description, processes, etc.
Based on this recommendation, standards for MPC applications in different fields can be defined.

**ITU-T X.1812 “Security framework based on trust relationship for IMT-2020 ecosystem” (under approval)** identifies the stakeholders in the IMT-2020 ecosystem, analyses the trust relationships amongst them, identifies threats and clarifies security responsibilities for each stakeholder, defines the security boundaries between stakeholders, and establishes a security framework based on the trust relationships.

**ITU-T Y.2086 “Framework and Requirements of decentralized trustworthy network infrastructure” (under approval)** specifies the framework and requirements of the decentralized network infrastructure. The decentralized network infrastructure is expected to enhance the trustworthiness of the network infrastructure via a universal basic framework for different kinds of high-level network services. This Recommendation includes the framework, requirements, and use cases of the decentralized network infrastructure.

[**ITU-T Y.3056 “Framework for bootstrapping of devices and applications for open access to trusted services in distributed ecosystems”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=14594): Rapid advancements in communications and associated technologies has led to the emergence of distributed ecosystems with a large number of devices, applications and use cases requiring open access to trusted services. This nature of open access to trusted services in distributed ecosystems can be provisioned by using the inherent security capabilities and mechanisms already present in the devices and the underlying networks. This Recommendation provides a concept of bootstrapping of devices and applications by network operators who can share the network security capabilities with users and providers of new devices and services. It describes the requirements to be fulfilled by the entities of the ecosystem such that they may benefit from the bootstrapping capabilities. Based on the requirements, a reference model as well as a functional architecture is provided, which together describe the elements, functions and reference points needed for provisioning of the bootstrapping capabilities. Finally, the Recommendation provides the information flows required to enable the bootstrapping capabilities.

**ITU-T Y.3057 “A trust index model for ICT infrastructures and services” (under approval)** describes a trust index model for ICT infrastructures and services. In order to provide a commonly applicable way for evaluating trust that covers different characteristics, trust index is a key concept for trust provisioning by considering trust value chain in ICT environment. Particularly, trust index, which can evaluate and quantify trust of stakeholders, is a comprehensive accumulation of trust indicators. This draft Recommendation identifies trust indicators that represent fundamental criteria for evaluating trust of entities in ICT environments. To represent characteristics of trust, trust indicators are categorized into two parts: objective trust indicators and subjective trust indicators. A list of trust indicators and an application of trust index are introduced.

I.5.4 Distributed Ledger Technology

**ITU-T F.747.10 “Requirements of distributed ledger systems (DLS) for secure human factor services” (Determined; Decision planned January 2022)** provides general requirements and functional capabilities for distributed ledger systems (DLS) for secure human factor services. This Recommendation describes the requirements for the secure human factor distributed ledger service model, which can solve conflicting goals of privacy protection and big personal human factor data utilization. This Recommendation also includes the functional capabilities for human factor distributed ledger shared nodes to perform machine learning without decryption on encrypted human factor data. However, the computational burden of machine learning for encrypted data may be excessive. To solve this problem, this human factor distributed ledger service model provides procedures for allowing the use of two or more encryption key pairs and notifying the key type. In addition, this Recommendation involves the integrity maintaining requirements for secure human factor services to maintain a safe distributed ledger and checked from the beginning to distribute personal human factor information. Therefore, the application of distributed ledger system in the distribution of personal secure human factor information can ensure transparent tracking from the distribution process to the final use path.

**ITU-T L.1317 “Guidelines on energy efficient blockchain systems” (under approval):** Several models have been introduced to calculate the urban energy system and to demonstrate the variants that calibrate the local energy efficiency. This Recommendation focuses on the impact of blockchain in energy efficiency. A literature analysis is performed with regard to the understanding of the blockchain energy demands and how these can be optimized. The aim of this Recommendation is to explain the energy demand of blockchain, to define the blockchain energy model and to describe the energy efficiency parameters that can be calibrated in order to enhance the corresponding energy efficiency.

[**ITU-T X.1405 “Security threats and requirements for digital payment services based on distributed ledger technology”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=14722)**:** Various digital financial services based on digital ledger technology are developed and operated in the real world including transaction accounts, payments services, saving accounts, investment services, and insurance services. This Recommendation focuses on payment services use cases. Based on the analysis of use cases, a service model is described and security threats and challenges are analysed. Then security requirements are specified against threats and challenges.

[**ITU-T X.1406 “Security threats to online voting system using distributed ledger technology”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=14734) identifies security threats to online voting system using DLT based on telecommunication/ICT infrastructure. It proposes a reference model of online voting system using DLT based on telecommunication/ICT infrastructure and analyses security threats in online voting process described in the models.

**ITU-T X.1407 “Security requirements for digital integrity proofing service based on distributed ledger technology” (under approval)** specifies the security threats and requirements in digital integrity proofing based on distributed ledger technology (DLT). The original proof protected is stored in the off-chain. The hashed data values are stored in the on-chain. This Recommendation analyses the security threats to the digital integrity proofing services based on DLT, namely, proof registration and proof provenance. This Recommendation describes the security requirements that could address these security threats.

**ITU-T X.1408 “Security threats and requirements for data access and sharing based on distributed ledger technology” (under approval)**: A distributed ledger technology (DLT) is defined as a shared digital ledger, or a continually updated list of all transactions. Data is accessed by a data controller (organization) and is possibly transferred to a data processor (organization) that will be responsible for processing the data on behalf of the data controller. A data controller should determine the purpose and the manner in which the data will be processed according to the constraints imposed by the data policy set by organizations. In this context, there is a necessity of trusted and transparent solution to enhance
1) traceability of the data being accessed by data controllers and data processors directly or indirectly;
2) verifiability that if the data was accessed, used, and transferred without violating the data policy set by organizations, and;
3) changeability of data status in case of modification of data policy or any other cases.
An important aspect of this solution is to enable trust and transparency on data accountability and provenance & usage tracking. It should offer transparent and controlled data access, sharing and processing, so that unauthorized users or untrusted servers cannot process data without the authorization.
This Recommendation focuses on the solution which provides a way to improve traceability of data, verifiability of data, and changeability of data status. The solution is suitable for implementation using private distributed ledger technology where data is accessed and shared less frequently. This Recommendation provides security threats and requirements for data access and sharing based on the distributed ledger technology (DLT). It describes the framework and models for data access and sharing based on DLT. It identifies entities and their roles for data access and sharing based on DLT. It also identifies security threats. In addition, security requirements that address these security threats are described.

[**ITU-T F.Sup4 “Overview of convergence of artificial intelligence and blockchain”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?rec=14651)**:** Artificial intelligence (AI) is one of core essential driving forces of a new round of industrial reform, which can affect promoting the upgrading of the traditional industries. Blockchain presents opportunities for disruptive innovations, which enables global businesses to transact with less friction and more trust. AI and blockchain promote and influence each other, and the convergence of them could bring big driving forces for industries a great creativity across a wide range of business applications in many fields. There are many benefits and challenges to combine AI and blockchain together. This Supplement focuses on the research on the convergence of AI and blockchain, specifically analyzes the mutual promotion between AI and blockchain, and provides a technical reference for the application of AI and blockchain. Besides, this Supplement also provides application analysis of the convergence of AI and blockchain.

I.6.1 Green ICT standards

[**ITU-T L.1024 “Effect for global ICT of the potential of selling services instead of equipment on the waste creation and environmental impacts”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=14564)**:** It is expected that currently billions of new ICT goods – smartphones and others - are sold annually and even more are expected in 2025. Business models based on servitization which would - most effectively - improve the circularity of these ICT goods are not well understood, e.g. prolonging the lifetime and/or the e-waste collection rate. The cases in the ICT ecosystem – for which the ICT goods - are better sold as services/subscriptions than products, are not clearly understood from an environmental point of view. This Recommendation utilises information compiled from stakeholders which can provide good insights into the specified potential challenge.

**ITU-T L.1033 “Guide for the institutions of higher learning to contribute in the effective life cycle management of e-equipment and e-waste” (under approval):** Managing e-waste has been a major problem in many countries. Emerging economies still face a multitude of challenges that hinder the effective management of e-equipment and e-waste. Many of them do not have suitable facilities to handle e-equipment and e-waste and have inadequate implementation frameworks and structures due to: the lack of quantifiable data and statistics on e-equipment and e-waste, inadequate policies, regulations, standards and enforcement strategies, low stakeholder engagement/collaboration and limited expertise. Institutions of higher learning have a crucial role in leading society through their influence and development of individuals. As societal issues become more complex and the boundaries between academia, industry, and government become unclear, institutions of higher learning must remain the cornerstone of development. Universities, among other higher learning institutions, are better placed to ensure that circularity of EEE is achieved so as to minimize the effects of WEEE. The role of universities as examples of institutions of higher learning, is to offer training, carry out research and share knowledge, ideas, research output and innovations developed and applied for their own benefit and for their surrounding communities. Universities have the capacity to develop curriculum on life cycle- economy processes, including e-waste management, for formal training and material for informal and non-formal training. Universities can also join efforts to research and provide reliable information that can be used in policy formulation, development of standards and strategies on imports and exports to the region. This Recommendation aims therefore to be a guide for institutions of higher learning to collaboratively contribute on key aspects of managing e-resources and e-waste. It explores how institutions of Higher learning can engage in EEE circularity by checking their effective involvement in every EEE and WEEE process.

**ITU-T L.1050 “Methodology to identify the key equipment in order to assess the environmental impact and e-waste generation of different network architectures” (under approval):** While an assessment framework for environmental impacts of the ICT sector does exist (as developed by ITU), best practices for equipment identification, developed specifically to assess the environmental impacts of network architecture, remain lacking. In this Recommendation, key equipment in the networks are identified for smoother LCA calculations. Different types of network architecture employ different goods which entail differences in terms of energy usage, e-waste generation as well as environmental footprints. This Recommendation will examine three types of network architectures and will suggest an appropriate set of equipment to be considered for each. This Recommendation will begin to support network designers in determining the environmental and circular performance of different network architectures. This Recommendation utilises information compiled from stakeholders which can provide good insights into the specified potential challenge.

[**ITU-T L.1060 “General principles for the green supply chain management of information and communication technology manufacturing industry”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=14717) focuses on establishing general principles for the green supply chain management of ICT manufacturing industry. It mainly gives the general principles for the green properties including upstream and downstream suppliers, logistics, recycling and utilization based on the product whole life cycle. General requirements such as the green supply chain management strategy, implementation, green production, recycling, green information disclosure will be proposed as well.

**ITU-T L.1317 “Guidelines on energy efficient blockchain systems” (under approval):** Several models have been introduced to calculate the urban energy system and to demonstrate the variants that calibrate the local energy efficiency. This Recommendation focuses on the impact of blockchain in energy efficiency. A literature analysis is performed with regard to the understanding of the blockchain energy demands and how these can be optimized. The aim of this Recommendation is to explain the energy demand of blockchain, to define the blockchain energy model and to describe the energy efficiency parameters that can be calibrated in order to enhance the corresponding energy efficiency.

**ITU-T L.1383 “Smart energy solutions for cities and home applications” (under approval)** focuses on smart energy solutions in different application scenarios basically on energy saving and carbon emission reduction. Besides their application in the field of ICT, such as base stations, data centers and telecom centers, smart energy solutions have eventually been applied in cities and homes as the advanced update of ICTs. Cities play a different role in different parts of the world. With the development of smart energy technologies, in cities is possible to answer key issues worldwide due to the urgent necessity of GHG emissions reduction. This Recommendation includes specific smart energy applications in cities and homes such as energy sources, energy management functions, etc.

[**ITU-T L.1471 “Guidance and criteria for information and communication technology organisations on setting Net Zero targets and strategies”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=14720): Currently, the definition of Net Zero and related concepts such as carbon neutrality, climate neutrality for organisations are still under development. Several initiatives, including, inter alia, the Science Based Target Initiative, the UNFCCC Race to Zero, ISO TC 207 and the Net Zero Initiative are working on defining and/or aligning the different views of these concepts to avoid confusion and reduce risks for green washing. In this situation, this Recommendation seeks to guide ICT organisations in clarifying the meaning of Net Zero in the context of the ICT sector and setting Net Zero targets and strategies. It also identifies actions that would lead the sector towards Net Zero according to the trajectories described in [ITU-T L.1470].

[**ITU-T L.Suppl.41 to ITU-T L-series of Recommendations “Requirements on energy efficiency measurement models and the role of AI and big data”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?rec=14761)**:** Several assessment models have been introduced to calculate the urban energy system and to demonstrate the variants that calibrate the local energy efficiency. This Supplement focuses on the impact of Artificial Intelligence (AI) and big data on energy efficiency. More specifically, this Supplement identifies a model that can calculate the energy efficiency in an urban space, from an AI and Big Data perspective. A literature analysis is performed with regard to the identification of existing energy efficiency assessment models under the lens of AI and big data and a special focus on the urban system, which results to an AI taxonomy for energy efficiency and to corresponding jobs (process steps) where big data are involved. This Supplement aims to unveil the requirements for energy efficiency assessment, and the features that affect the energy demand. It attempts to define a unified assessment model for energy efficient cities.

[**ITU-T L.Suppl.42 to ITU-T L-series of Recommendations “Guidelines on the Environmental Efficiency of Machine Learning Processes in Supply Chain Management”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?rec=14756) provides guidelines on the environmental efficiency of machine learning (ML) processes in supply chain management. This guidance document is intended to support machine learning researchers and operators to measure and improve the environmental efficiency of ML, and other emerging technologies (e.g. Blockchain, Big Data, 5G, …) use in supply chain management.

[**ITU-T L.Suppl.43 to ITU-T L-series of Recommendations “Smart energy saving of 5G base station: Based on AI and other emerging technologies to forecast and optimize the management of 5G wireless network energy consumption”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?rec=14762) explores how network energy saving technologies that have emerged since the 4G era, such as carrier shutdown, channel shutdown, symbol shutdown etc., can be leveraged to mitigate 5G energy consumption. It also analyses how enhanced technologies like deep sleep, symbol aggregation shutdown etc., have been developing in the 5G era. This report aims to detail these fundamentals. However, it is far away from being enough, a revolutionized energy saving solution should be taken into consideration. In response to the requirement of an intelligent and self-adaptive energy saving solution, artificial intelligence (AI) and big data technology are introduced to form a more precise energy saving strategy based on specific site traffic and other site-related conditions, thus improving the efficiency and reducing the manpower required. More details about AI-driven smart energy saving solution will be elaborated. This Supplement could help achieve the most energy-efficient network with good performance and lower operating expense (OPEX) for the mobile network operators (MNOs).

[**ITU-T L.Sup.44 “A Guideline on best practices and environment friendly policies for effective ICT deployment methods”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?rec=14763)**:** In accordance to the instructions and directives of WTSA-16 on Resolution 73, “Study Group 5 is to develop an appropriate Recommendation on ICTs, the environment and climate change issues within the mandate and competency of ITU T, including telecommunication networks used for monitoring and adapting to climate change”. This document intends to identify best practices and opportunities for new applications using ICTs to foster environmental sustainability, identify appropriate actions and promote best practices towards implementing environmental friendly policies and practices. This document also includes a questionnaire that has been developed to gather relative information from stakeholders for use cases and key success factors, including exemplary collection of green best practices to ultimately formulate a Guideline on best practices and environment friendly policies for effective ICT deployment methods.

I.6.2 Electromagnetic fields

[**ITU-T K.20 (revised) “Resistibility of telecommunication equipment installed in a telecommunication centre to overvoltages and overcurrents”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=14723) specifies resistibility requirements and test procedures for telecommunication equipment that is attached to or installed within a telecommunication centre. Overvoltages and overcurrents covered by Recommendation ITU-T K.20 include surges due to lightning on or near the line plant, short term induction from adjacent alternating current (AC) power lines or railway systems, earth potential rise due to power faults, direct contact between telecommunication lines and power lines, and electrostatic discharges (ESDs). The sources for overvoltages in internal lines, between equipment or racks, are mainly inductive coupling caused by lightning currents being conducted in nearby lightning strikes or lightning currents being conducted in nearby conductors. Major changes compared with Recommendation ITU-T K.20 (2017) include:

– DC insulation resistance test;

– revised test exemption for internal short cables;

– renaming of some test titles for clarity;

– screened cable exemptions;

– addition of test 7.10, a twisted pair port transverse/differential test, to Table 7.

[**ITU-T K.52 (revised) “Guidance on complying with limits for human exposure to electromagnetic fields”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=14724) aims to help with compliance of telecommunication installations and mobile handsets or other radiating devices used against the head with safety limits for human exposure to electromagnetic fields (EMFs). It presents general guidance, a calculation method and an installation assessment procedure. The assessment procedure for telecommunication installations, based on safety limits provided by the International Commission on Non-Ionizing Radiation Protection (ICNIRP), helps users determine the likelihood of installation compliance based on accessibility criteria, antenna properties and emitter power. The IEC Standard for the compliance measurement of mobile handsets is recommended.

[**ITU-T K.56 (revised) “Protection of radio base stations against lightning discharges”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=14293) presents the techniques applied to a telecommunication radio base station in order to protect it against lightning discharges. The need of protection is obtained from the methodology contained in IEC 62305-2, which is used to determine the relevant lightning protection level (LPL) for the installation. The protection techniques for the external area cover the lightning protection system (LPS), bonding procedures, earthing and the installation of surge protective devices (SPDs) at the power meter station. The protection techniques for the equipment building cover the feeder and lighting cables, the electric power conductors, the telecommunication cabling and the earthing/bonding procedures applied to cable trays and equipment frames. This Recommendation also provides guidelines in order to achieve adequate protection of the telecommunication equipment based on the coordination between equipment resistibility, SPD protection level and installation characteristics.

[**ITU-T K.90 Amd.1 (revised) “Software "EMFACDC" v 2.0”**](https://www.itu.int/rec/T-REC-K.90-201905-I%21Amd1)**:** The software “EMFACDC” in Appendix II of ITU-T Recommendation K.90 was revised in 2019. In the new version v.2.1 of the EMFACDC software, some bugs that cause problems with reading and writing data to a \*.csv file have been fixed.

[**ITU-T K.100 (revised) “Measurement of radio frequency electromagnetic fields to determine compliance with human exposure limits when a base station is put into service”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=14725) provides information on measurement techniques and procedures for assessing compliance with the general public electromagnetic field (EMF) exposure limits when a new base station (BS) is put into service, taking into account effects of the environment and other relevant radio frequency sources present in its surroundings.

[**ITU-T K.112 (revised) “Lightning protection, earthing and bonding: Practical procedures for radio base stations”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=14298) provides a set of practical procedures related to the lightning protection, earthing and bonding of a radio base station (RBS). It considers two types of RBS: those that are stand-alone installations, comprising a tower and the associated equipment and those that are installed on the roof of a building. In both cases, this Recommendation provides the procedures for the design and installation of the lightning air-termination system, down-conductors, earthing network, bonding conductors and surge protective devices (SPDs). This includes the specification of the materials, anti corrosion protection and special treatment for rocky areas. Particular attention is directed to the protection of the navigation light systems and of the electric power conductors that feed the RBS, especially in the case where the RBS is installed on the roof of a building. Annex A presents practical examples of earthing network design, whereas Annex B presents an overview of the techniques for measuring the earthing resistance and the earth resistivity.

**ITU-T K.147 (revised) “Ethernet port resistibility testing for overvoltages and overcurrents” (under approval)**: Ethernet, using twisted-pair cabling, is a ubiquitous communications link, which also can act as a powering feed. Usually, Ethernet is implemented as a star network and terminal ports can be independently tested for resistibility. Where equipment has multiple independent Ethernet ports, such as central hubs, switches, or repeaters, then testing is required for inter-port resistibility. Resistibility testing needs to test for lightning transients coupled into a network by magnetic induction, earth potential rise, resistive coupling and transient coupling by a voltage-limiting operation of surge protective functions or flashover. The voltage limiting operation may convert common-mode surges into differential-mode surges in the signal path. It is also possible for alternating current (AC) mains power faults to couple into the network. Recommendation ITU-T K.147 covers the different Ethernet implementations, their configurations, how surges are coupled into the system and what surge mitigation measures are used. Following this overview, the rational for the different surge and power fault test circuit approaches and when they are specified is given.

[**ITU-T K.Suppl.1 (revised) to ITU-T K-series Recommendations “ITU-T K.91 – Guide on electromagnetic fields and health”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?rec=14316)**:** The objective of Supplement 1 to the ITU-T K-series Recommendations is to answer questions commonly posed by the public on the electromagnetic field (EMF) phenomenon and to address related concerns. This Guide on electromagnetic fields and health aims to:

• Provide electromagnetic field (EMF) information and education resources suitable for all communities, stakeholders and governments.

• Support clarification of the science by referencing the World Health Organization (WHO) and other stakeholders (see NOTE) that provide information that is particularly useful in helping to clarify scientific uncertainties e.g., in the areas of radio frequency (RF) technology, infrastructure implementation, usage and consequential EMF exposure.

NOTE – The primary reference on EMF and health is the World Health Organization (WHO). The primary reference on EMF assessment methods is the International Telecommunication Union (ITU) and the International Electrotechnical Commission (IEC).

[**ITU-T K.Suppl.21 (revised) to Recommendation ITU-T K.21 “Rationale for setting resistibility requirements of telecommunication equipment installed in customer premises against lightning”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?rec=14316) provides technical information (rationale) for setting the resistibility requirements against lightning contained in [ITU-T K.21]. This information should be referred to in the case of revision of [ITU-T K.21]. The rationale described in this Supplement is mainly quoted from past contributions and other documents discussed in ITU-T SG5 at the stage of establishment and revision of [ITU-T K.21]. This is a living document in that the rational justifying any future changes in Recommendation ITU-T K.21 testing should be added to this Supplement. This Supplement references the tables, test numbers and test conditions found in [ITU-T K.21]. Rational information for the [ITU-T K.21] test values originates from various events, surveys, standards and ITU-T SG5 contributions.

[**ITU-T K.Suppl.22 (revised) to Recommendation ITU-T K.45 “Rationale for setting resistibility requirements of telecommunication equipment installed in the access and trunk networks against lightning”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?rec=14580) provides technical information (rationale) for setting the resistibility requirements against lightning in [ITU-T K.45]. This information should be referred to in the case of revision of [ITU-T K.45]. The rationale described in this Supplement is mainly quoted from past contributions and other documents discussed in ITU-T SG5 at the stage of establishment and revision of [ITU T K.45]. This is a living document in that the rational justifying any future changes in [ITU-T K.45] testing should be added to this Supplement. This Supplement references the tables, test numbers and test conditions found in [ITU-T K.45]. Rational information for the [ITU-T K.45] test values originates from various events, surveys, standards and ITU-T SG5 contributions.

[**ITU-T K.Suppl.24 to ITU-T K-20 series Recommendations “Rationale for setting resistibility requirements of telecommunication equipment installed in a telecommunication centre against lightning”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?rec=14753)**:** The technical information (rationale), that the discussions were based on, is shown in past contributions to SG5 or other documents, however, it is not organized as any informative documents and not easy to look for such past documents. Furthermore, the users of Recommendation K.20 who do not have an ITU account, cannot access such information in the contributions or other documents. Therefore, this supplement includes the technical information (rationale) for setting the resistibility against lightning in K.20 is based on, from past contributions and/or other documents discussed in SG5.

[**ITU-T K.Suppl.25 to ITU-T K-series of Recommendations “ITU-T K.117 – Long reach single twisted-pair Ethernet resistibility testing”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?rec=14754)**:** Short distance single pair Ethernet (SPE) is well established in the automotive industry. The evolved 10 Mb/s SPE, with up to 1 km or more of link length, is aimed at industrial, building and security applications. This relatively new Ethernet variant is still being standardised and a full set of preferred implementation components are not widely available. The first part of this Supplement overviews the SPE system before proposing possible SPE surge protective device (SPD) test circuits.

The long distance between the SPE terminal equipment means that coupled transients can be significantly larger than tested for in K.117. The transient levels are higher due to local earth potential rise differences and Ethernet link cable length. The SPE configuration combines the Ethernet signal and any powering voltage on the two SPE link conductors making the separate measurement of signal and powering protection performance more complicated. Field data on 10 Mb/s, 1 km SPE resistibility was minimal in 2020 due to lack of deployment. In 2021 there should be wider availability of support hardware such as cable, connectors and Ethernet PHY transceivers. This supplement is necessarily predictive on resistibility requirements. Once 10 Mb/s, 1 km SPE is widely deployed and field data is available, resistibility requirements can be based on such data and incorporated in the appropriate K Recommendations. Certain sections are still under study.

[**ITU-T K.Suppl.26 to ITU-T K-series of Recommendations “Analysis of electromagnetic compatibility requirements and test methods of 5G Active Antenna System base station”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?rec=14755): AAS known as active antenna system is widely spread within communication systems and vertical industries with its benefit of higher beam-forming gain which can overcome the high path loss of higher carrier frequency. For the introduction of AAS especially the integrated antenna array, corresponding electromagnetic compatibility test configuration and measurement methods should be paid to special attention. Radiated immunity as an example will increase dramatically as the antenna array gain cannot be distinguished. Other technical issues such as radiated immunity test, communication link establishment, performance assessment, EMF exposure problem for test personnel, etc. are also proposed.

I.6.4 Emergency communication & disaster relief

I.6.5 Naming, numbering, addressing and identification

[ITU-T E.157 (revised) “International calling party number delivery”](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=14649) provides guidance for international calling party number delivery across boundaries of countries which is technology neutral.

[**ITU-T Technical Report TR.EENM “Guidelines for effective and efficient national E.164 numbering plan administration”**](https://www.itu.int/pub/publications.aspx?lang=en&parent=T-TUT-TLCMGT-2021) aims to provide the most effective, efficient methods and guidelines for national E.164 numbering plan administrations depending on best practices.

[**ITU-T TR.spoofing “Countering Spoofing”**](https://www.itu.int/pub/publications.aspx?lang=en&parent=T-TUT-TRUST-2021): The purpose of this Technical Report is not on the development of anti-fraud and identity verification platforms, but on providing information that could assist in implementing measures to counter spoofing. Calling Party Number authentication mechanisms are not a global solution against fraud or spoofing, and their development is covered specifications of other technical standardization bodies.

I.7 Tariff and accounting principles and international telecommunication/ICT economic and policy issues

I.7.1 Economic impact of IXP, Universal service, NGN, Mobile Roaming and SMPOTT and Valuation of spectrum

[**ITU-T D.600R Amd.1 “Cost methodology for the regional tariff group for Africa applicable to the international automatic telephone service – Annex B: Guidelines for implementing efficient cost models for telecommunication service tariffs in the Africa region”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?rec=5151)provides guidelines to Member States of the Africa region for the construction of costing model, within the framework of the approval of prices of telecommunication services, taking into account the technological development and innovation in the field of telecommunications as well as the specificity of each country.

[**ITU-T D.607 R “One network area roaming”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?rec=14367) based on African regional experiences, aims to promote regional integration by bringing down the high cost of mobile roaming. It provides a framework and tools for facilitating and making affordable international telecommunications services to and from Africa’s countries.

**ITU-T D.608R “OTT Voice Bypass” (under approval):** OTT voice bypass is now widely recognised as a form of traffic bypass and a growing source of losses for international inbound voice revenues. The regional Recommendation will focus on national and regional collaboration between member states and operators to deal with the OTT voice bypass issue.

[**ITU-T D.1041 “Policy and methodological principles for determining co-location and access charges”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?rec=14426) offers policy and methodological principles for Member States interested in establishing transparent co-location access and service rates. Co-location is an important telecommunications wholesale service, essential to a competitive telecommunications landscape and a sustainable environment, as it eliminates the need for operators to buildout new or replicate existing infrastructure. A key component for encouraging co-location is the establishment of reasonable co-location access and service rates on the principles of fairness and equity.

**ITU-T D.1102 “Customer redress and consumer protection mechanisms for OTTs” (under approval)** proposes possible customer redress and consumer protection mechanisms related to the provision and consumption of OTTs. This comes in the wake of the increasing use of over the top (OTT) applications for voice calling, instant messaging and video calling in the absence of an international framework to ensure consumer protection and redress where necessary.

I.8 Quality of service and experience, and network performance

[**ITU-T E.805.1 “Quality of service operational strategy for improved regulatory supervision of providers of mobile telecommunication services”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=14589)provides guidance to telecommunication regulators on how to achieve their regulatory goals for quality of service (QoS) at reduced regulatory effort and improved operational efficiency, thereby providing desired benefits to consumers and providers of mobile telecommunication services. Telecommunication regulators involved in QoS supervision often face challenges on how mobile QoS within their respective jurisdictions can be enforced in a cost-effective manner and over a desired turnaround time, while not compromising reliability in QoS assessment outcomes.

**ITU-T M.3365 “Requirements for QoE management of video in visual surveillance” (under approval)** introduces requirements for QoE management of video in visual surveillance, includes management of video resource, management of QoE indicators for video, configuration management of QoE evaluation activity, management of QoE evaluation record. This Recommendation provides the scenario of video quality evaluation system, which is a tool that implements the requirements given in this Recommendation. This Recommendation also gives examples of video quality evaluation record for reference.

[**ITU-T P.57 (revised) “Artificial ears”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=14662) specifies the electro-acoustical characteristics of artificial ears to be used for telephonometric measurements. Four devices are specified: a telephone band type for measurements on traditional telephone sets, an insert earphone type, a type faithfully reproducing the characteristics of the human ear and a type faithfully reproducing the characteristics of the human ear including an average adult human ear canal.

**ITU-T P.58 (revised) “Head and torso simulator for telephonometry”** specifies the electroacoustic characteristics of the head and torso simulator (HATS) to be used for telephonometric measurements. Both the sound generation and sound pick up characteristics of this device are specified. The artificial ears described in this Recommendation support narrowband, wideband, super-wideband, as well as full-band applications. The artificial mouth described in this Recommendation supports narrowband, wideband and super-wideband applications. However, it should be noted that the directionality of the artificial mouth is limited in its ability to simulate the human mouth in the super-wideband frequency range.

[**ITU-T P.383 “Technical requirements and test methods for digital wired or wireless headset interfaces”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=14691)**:** Headsets and headphones equipped with wired or wireless digital interfaces have been widely used in digital mobile terminals during recent years. The consumer is free to choose either the headset or the headphone originally provided with the terminal or other headsets or headphones that are offered separately. However, the quality of service and quality of experience (QoS/QoE) perceived by users is influenced by both the electrical performance of the interface and the compatibility between the terminal and the headset or headphone. Recommendation ITU-T P.383 specifies requirements and provides corresponding test methods for headsets and headphones as well as terminals, when tested separately.

[**ITU-T P.700 (revised) “Calculation of loudness for speech communication”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=14664) describes a unified method required for calculating loudness, allowing comparison of narrowband (NB) (300-3.4k Hz), wideband (WB) (100-8k Hz), super-wideband (SWB) (50-14k Hz) and fullband (FB) (10-20k Hz) telephony, for all types of terminals including handset, hands-free and conference terminals. The model described in this Recommendation is consistent when switching from one bandwidth to another and independent of the listening situation (e.g., handset, headset, hands-free) with regards to producing a constant perceived loudness. Compared to loudness rating (LR) models, like the one presented in ITU-T P.79, the present method predicts the absolute loudness, considers auditory masking and is applicable to a wide range of acoustic levels. This Recommendation incorporates a number of annexes that hold test vectors for validation of loudness model implementations as well as of the descriptions and results of the loudness experiments that form the basis for this Recommendation.

[**ITU-T P.808 (revised) “Subjective evaluation of speech quality with a crowdsourcing approach”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=14665) describes a crowdsourcing approach for conducting subjective evaluations of speech quality. In comparison to laboratory tests, tests using a crowdsourcing approach rely on participants that are connected via an online platform, and whose task is to evaluate speech quality in their own environments, using their own devices. This Recommendation gives guidance on the test material, experimental design, and the procedure for conducting listening tests in the crowd. The methods are to be seen as complementary to laboratory-based evaluations which are described in ITU-T P.800 and ITU T P.835.

[**ITU-T P.913 (revised) “Methods for the subjective assessment of video quality, audio quality and audiovisual quality of Internet video and distribution quality television in any environment”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=14704) describes non-interactive subjective assessment methods for evaluating the one-way overall video quality, audio quality or audiovisual quality for applications such as Internet video and distribution quality video. These methods can be used for several different purposes including, but not limited to, comparing the quality of multiple devices, comparing the performance of a device in multiple environments, and subjective assessment where the quality impact of the device and the audiovisual material is confounded.

[**ITU-T Y.1545.1 Amd.1 “Framework for monitoring the quality of service of IP network services - Amendment 1”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=14699) gives guidance to regulators about QoS parameters for evaluating the quality of internet services, QoS evaluation scenarios and sampling methodologies. Amendment 1 introduces text for the radio coverage availability parameter, which was previously identified for further study.

[**ITU-T Y.3109 “QoS assurance-related requirements and framework for virtual reality delivery using mobile edge computing supported by IMT-2020**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=14396)**”** specifies Quality of Service (QoS) requirements and a framework for virtual reality delivery using mobile edge computing in IMT-2020. It first provides an introduction on virtual reality delivery using mobile edging computing supported by International Mobile Telecommunications (IMT) 2020 network. It then specifies QoS requirements and a framework. The classification of VR services and the detailed VR service factors that become a basis for identifying requirements are specified in Appendix I and II. The typical VR user cases and guidelines for deployments of VR services are described in Appendix III and VI.

[**ITU-T Y.3113 “Requirements and framework for latency guarantee in large scale networks including IMT-2020 network”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=14595): For the latency guarantee in multi-domain large scale networks, it is necessary to clarify how the numerous data-plane functional entities should be arranged and operate in conjunction with others. In order for the solution to be both effective and efficient, selecting a proper traffic granularity for network treatment is essential. Various granularity of flow aggregates, between flow and class, should be taken into consideration. In the Internet or the IMT-2020 network there are inevitably multiple domains with possibly different QoS architectures. Even with multiple heterogeneous domains there should be an underlying unified resource reservation and admission control functions, while the data plane functions should be based on flow aggregates and proper regulations in the middle of an end-to-end path. Therefore, this Recommendation specifies the requirements and the framework for effective and efficient solutions for latency guarantee and the cooperation among heterogeneous QoS domains.

**ITU-T Y.3806 “Quantum key distribution networks - Requirements for QoS assurance” (under approval)** elaboratesthe high-level and functional requirements of QoS assurance for quantum key distribution networks (QKDN). The functional requirements include QoS planning, QoS monitoring, QoS optimization, QoS provisioning, QoS protection and recovery.

[**ITU-T Y.Suppl.60 (revised) “Interpreting ITU-T Y.1540 maximum IP-layer capacity measurements”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?rec=14707) provides information on interpreting ITU T Y.1540 maximum IP-layer capacity measurements as described in Annex A and Annex B of the Recommendation. This Supplement also provides useful information for those who measure various technologies. Much has been learned as part of the extensive testing campaigns thus far, and there is more to learn. Therefore, this Supplement may be updated frequently, and readers are encouraged to ensure that they have the most recent version.

I.9 Conformity, interoperability and testing

[**ITU-T Q.4068 “Open APIs for interoperable testbed federations”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=14765): The recent technological developments concerning Internet are more complex to test and to use then in the real world. They have to address a larger diversity of conditions and assess their scalability. The needs to do experimentations within testbeds become more important to test new use cases in real conditions. This evolution increases the need and practice to federate and interconnect different testbeds. However, this powerful approach lacks the availability of clearly standardized APIs to support such federation of existing testbeds and resources to support experimentation, test and validation of new technologies, services and solutions in order to enhance the interoperability of testbeds. This Recommendation presents a set of open APIs for interoperable testbed federation able to manage not only the interconnection and the interoperability of testbeds in a federation, but also to handle the resources advertisement, allocation and provision. The APIs are designed to manage the users involved in the federation like the experimenters and to assign roles to the users. In the same way, the usage of a resource is attributed to an experimenter through the open APIs for interoperable testbed federation.

I.9.1 Testing energy efficiency of base stations

I.9.2 Testing cloud computing

[**ITU-T Q.4044 “Test suite for interoperability testing of virtual switch”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=14764) provides test suite for interoperability testing of virtual switch, which contains test cases specifying the test objective, test procedures and expected results.

I.10 Mainstreaming accessibility in ICTs

[**ITU-T Technical Paper HSTP.ACC-UC "Use cases for inclusive media access services"**](https://www.itu.int/pub/publications.aspx?lang=en&parent=T-TUT-FSTP-2021-ACC.UC) describes use cases for multimedia accessible system. This Technical paper describes an experiment of IPTV services with accessibility functions based on ITU-T Recommendation about accessibility profiles for IPTV systems.

I.11 Combating Counterfeiting and the use of stolen ICT devices

[**ITU-T Q.5053 “Mobile device access list audit interface”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=14587) defines the methodologies and interfaces between Mobile device access list audit system (MDALAS) and Mobile Network Operators’ Equipment Identity Register (EIR) to audit and reconcile whether the MNOs are complying with the defined Mobile device access list requirements. This document proposes different types of methodologies and interfaces to check and reconcile the Mobile device access list used by the MNOs to comply with the regulations with the Mobile device access list Audit System (MDALAS).

[**ITU-T Q Suppl.73 “Guidelines for permissive versus restrictive system implementations to address counterfeit, stolen and illegal mobile devices”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=14608)**:** There are two types of mechanisms and technology platforms available to address the issues related to counterfeit, illegal and stolen mobile devices in a country. There are inherent pros and cons of each approach. This document provides detailed and comprehensive understanding of the underlying matters that should be clearly recognized, understood and addressed in order to have a successful system implementation.

Over the last few years many governments and countries have realized the importance and necessity of implementing technical solutions to combat the issues associated with the influx of counterfeit mobile devices, illegal import of mobile phones and mobile theft. Given the complexities and the impact associated with the system implementation due to the requirements to handle these enormous issues, it is no wonder that governments are inundated with many difficult questions that are challenging to answer. The governments are generally not equipped with the technical expertise, especially in countries where the above-mentioned problems are most prevalent. For the governments with the prime responsibility of developing the regulatory framework required for ensuring a smooth system deployment without causing any inconveniences to the consumers, operators or importers, this creates a dependency on vendors and solution providers who offer technical solutions to address the above-mentioned issues.

There are two types of mechanisms available – Permissive and Restrictive – that are available and can be deployed; however, it is rather difficult for the governments to find accurate and balanced information that covers all aspects for a complex deployment and its impact on various elements including the government, device manufacturers, local assembly, operators, importers, and most importantly the consumers. This has resulted in a need to provide comprehensive information to the governments so that they fully understand all relevant aspects and issues of system implementation and its impact on all stakeholders in the country. Only equipped with this knowledge, the governments could determine and decide the best course of action and the right technical solution that suits their countries’ needs and caters to local dynamics of the society.

This supplement provides detailed information on the two mechanisms and highlights the strengths and weaknesses of each approach. Additionally, it provides guidelines to ensure a successful system implementation with a broad range of comprehensive measures to be adopted to combat the said issues.

[**ITU-T Q Suppl.74 “Roadmap for the Q.5050-series - Combat of Counterfeit ICT and Stolen Mobile Devices”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=14609) specifies the index and relation for the ITU-TQ.5050-series Recommendation, Technical Reports and Supplements on the combat of counterfeit ICT and stolen mobile devices.

I.12 Signalling Protocols

[ITU-T Q.4101 “Hybrid peer-to-peer (P2P) communications: Tree and data recovery procedures”](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=14766) specifies procedures for construction and recovery of a tree-based hybrid overlay network as well as recovery of data lost during reconstruction of the overlay network. The hybrid overlay network is capable of distribution of real-time data using its virtual tree-based overlay network, and distribution of large data using mesh-based overlay network by interaction with managed peer-to-peer network specified in Rec. ITU-T X.609 series. In the case of tree-based overlay network, it is crucial to keep the tree robust regardless of unexpected leave of intermediate peers. Especially, unlike mesh-based overlay network, any hybrid peer in a CoreTree can generate and broadcast its data to an overlay network at any time. That is, there are multiple data sources within an overlay network, and it may lead network segmentation on the leave of intermediate peer. This Recommendation provides procedures for recovering the tree-based hybrid overlay network as soon as possible, and also provides data recovery procedures for the data lost during tree reconstruction. In the case of data recovery, this Recommendation provides two recovery modes, which are push and pull mode. The data recovery mode is specified on its creation by an owner of the overlay network based on the characteristics of data to be distributed over the network.

I.13 Formal Languages and Identification

[**ITU-T X.680 | ISO/IEC 8824-1 (revised) “Information technology – Abstract Syntax Notation One (ASN.1): Specification of basic notation”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=14468) provides a notation called Abstract Syntax Notation One (ASN.1) for defining the syntax of information data. It defines a number of simple data types and specifies a notation for referencing these types and for specifying values of these types. The ASN.1 notations can be applied whenever it is necessary to define the abstract syntax of information without constraining in any way how the information is encoded for transmission.

[**ITU-T X.681 | ISO/IEC 8824-2 (revised) “Information technology – Abstract Syntax Notation One (ASN.1): Information object specification”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=14469) provides the ASN.1 notation which allows information object classes as well as individual information objects and sets thereof to be defined and given reference names. An information object class defines the form of a conceptual table (an information object set) with one column for each field in the information object class, and with each complete row defining an information object.

[**ITU-T X.682 | ISO/IEC 8824-3 (revised) “Information technology – Abstract Syntax Notation One (ASN.1): Constraint specification”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=14470) provides the ASN.1 notation for the general case of constraint and exception specification by which the data values of a structured data type can be limited. The notation also provides for signalling if and when a constraint is violated.

[**ITU-T X.683 | ISO/IEC 8824-4 (revised) “Information technology – Abstract Syntax Notation One (ASN.1): Parameterization of ASN.1 specifications”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=14471) defines the provisions for parameterized reference names and parameterized assignments for data types which are useful for the designer when writing specifications where some aspects are left undefined at certain stages of the development to be filled in at a later stage to produce a complete definition of an abstract syntax.

[**ITU-T X.690 | ISO/IEC 8825-1 (revised) “Information technology – ASN.1 encoding rules: Specification of Basic Encoding Rules (BER), Canonical Encoding Rules (CER) and Distinguished Encoding Rules (DER)”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=14472) defines a set of Basic Encoding Rules (BER) that may be applied to values of types defined using the ASN.1 notation. Application of these encoding rules produces a transfer syntax for such values. It is implicit in the specification of these encoding rules that they are also used for decoding. This Recommendation | International Standard defines also a set of Distinguished Encoding Rules (DER) and a set of Canonical Encoding Rules (CER) both of which provide constraints on the Basic Encoding Rules (BER). The key difference between them is that DER uses the definite length form of encoding while CER uses the indefinite length form. DER is more suitable for the small encoded values, while CER is more suitable for the large ones. It is implicit in the specification of these encoding rules that they are also used for decoding.

[**ITU-T X.691 | ISO/IEC 8825-2 (revised) “Information technology – ASN.1 encoding rules: Specification of Packed Encoding Rules (PER)”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=14473) describes a set of encoding rules that can be applied to values of all ASN.1 types to achieve a much more compact representation than that achieved by the Basic Encoding Rules and its derivatives (described in Rec. ITU-T X.690 | ISO/IEC 8825-1).

[**ITU-T X.692 | ISO/IEC 8825-3 (revised) “Information technology – ASN.1 encoding rules: Specification of Encoding Control Notation (ECN)”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=14474) defines the Encoding Control Notation (ECN) used to specify encodings (of ASN.1 types) that differ from those provided by standardized encoding rules such as the Basic Encoding Rules (BER) and the Packed Encoding Rules (PER).

[**ITU-T X.693 | ISO/IEC 8825-4 (revised) “Information technology – ASN.1 encoding rules: XML Encoding Rules (XER)”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=14475) specifies rules for encoding values of ASN.1 types using the Extensible Markup Language (XML).

[**ITU-T X.694 | ISO/IEC 8825-5 (revised) “Information technology - ASN.1 encoding rules: Mapping W3C XML schema definitions into ASN.1”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=14476) defines rules for mapping an XSD Schema (a schema conforming to the W3C XML Schema specification) to an ASN.1 schema in order to use ASN.1 encoding rules such as the Basic Encoding Rules (BER), the Distinguished Encoding Rules (DER), the Packed Encoding Rules (PER) or the XML Encoding Rules (XER) for the transfer of information defined by the XSD Schema.

[**ITU-T X.695 | ISO/IEC 8825-6 (revised) “Information technology - ASN.1 encoding rules: Registration and application of PER encoding instructions”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=14477) specifies the rules for applying PER encoding instructions using either type prefixes or an encoding control section.

[**ITU-T X.696 | ISO/IEC 8825-7 (revised) “Information technology - ASN.1 encoding rules: Specification of Octet Encoding Rules (OER)”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=14478) specifies two sets of binary encoding rules that can be applied to values of all ASN.1 types using less processing resources than the Basic Encoding Rules and its derivatives (described in Rec. ITU T X.690 | ISO/IEC 8825-1) and the Packed Encoding Rules (described in Rec. ITU-T X.691 | ISO/IEC 8825 2).

[**ITU-T X.697 | ISO/IEC 8825-8 (revised) “Information technology - ASN.1 encoding rules: Specification of JavaScript Object Notation Encoding Rules (JER)”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=14479) specifies a set of JavaScript Object Notation Encoding Rules (JER) that may be used to derive a transfer syntax for values of types defined in Rec. ITU-T X.680 | ISO/IEC 8824-1, Rec. ITU T X.681 | ISO/IEC 8824-2, Rec. ITU-T X.682 | ISO/IEC 8824-3, Rec. ITU-T X.683 | ISO/IEC 8824-4. It is implicit in the specification of these encoding rules that they are also to be used for decoding.

[**ITU-T Z.100 (revised) “Specification and Description Language - Overview of SDL-2010”**](https://www.itu.int/rec/T-REC-Z.100-202106-I) introduces the Specification and Description Language, intended for unambiguous specification and description of telecommunication systems. The scope of the Specification and Description Language is elaborated in clause 1. The ITU-T Z.100 series for SDL 2010 together form a reference manual for the language. The objective of this Recommendation is to provide an introductory overview to the language and the rest of the reference manual contained in the ITU-T Z.100 series for SDL 2010. The language introduced in this document is more fully defined in other Recommendations in the ITU-T Z.100 series for SDL 2010.

[**ITU-T Z.100 Annex F2 (revised) “Specification and Description Language - Overview of SDL-2010 - SDL formal definition: Static semantics”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=14702) describes the static semantic constraints of SDL 2010, the mapping to the abstract grammar and the transformations identified by the 'Model' clauses of Recommendations ITU T Z.101, Z.102, Z.103, Z.104, Z.105 and Z.107, that are included by reference in Recommendation ITU T Z.100.

[**ITU-T Z.100 Annex F3 (revised) “Specification and Description Language - Overview of SDL-2010 - SDL formal definition: Dynamic semantics”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=14703) defines the SDL 2010 dynamic semantics.

[**ITU-T Z.101 (revised) “Specification and Description Language - Basic SDL-2010”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=14671) defines the basic features of the Specification and Description Language. Together with Recommendations ITU-T Z.100, ITU-T Z.102, ITU-T Z.103, ITU T Z.104, ITU-T Z.105, ITU T Z.106 and ITU-T Z.107, this Recommendation is part of a reference manual for the language. The language defined in this document covers the essential features of the language, which is further defined in other Recommendations in the ITU-T Z.100 series.

[**ITU-T Z.102 (revised) “Specification and Description Language - Comprehensive SDL-2010”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=14672) defines the comprehensive features of the Specification and Description Language. Together with Recommendations ITU-T Z.100, ITU-T Z.101, ITU-T Z.103, ITU T Z.104, ITU-T Z.105, ITU-T Z.106 and ITU-T Z.107, this Recommendation is part of a reference manual for the language. The language defined in this document covers features of the language not included in Basic SDL 2010 in Recommendation ITU-T Z.101. These features provide comprehensive coverage of abstract grammar of the language except some data features covered in ITU-T Z.104 (and ITU-T Z.107 for object-oriented data).

[**ITU-T Z.103 (revised) “Specification and Description Language - Shorthand notation and annotation in SDL-2010”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=14673) defines the shorthand and annotation features of the Specification and Description Language. Together with Recommendations ITU-T Z.100, ITU-T Z.101, ITU-T Z.102, ITU-T Z.104, ITU-T Z.105, ITU T Z.106 and ITU-T Z.107, this Recommendation is part of a reference manual for the language. The language defined in this document covers features of the language not included in Basic SDL 2010 in Recommendation ITU TZ.101 or Comprehensive SDL 2010 in Recommendation ITU-T Z.102. Features defined in this Recommendation either do not have their own abstract grammar and are transformed to concrete grammar defined by Recommendations ITU T Z.101, ITU T Z.102 and ITU-T Z.104 (and ITU-T Z.107 for object-oriented data), or are annotations with no formal meaning.

[**ITU-T Z.104 (revised) “Specification and Description Language - Data and action language in SDL-2010”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=14674) defines the data features of the Specification and Description Language so that data definitions and expressions are well defined. Together with Recommendations ITU T Z.100, ITU-T Z.101, ITU-T Z.102, ITU-T Z.103, ITU-T Z.105, ITU-T Z.106 and ITU-T Z.107, this Recommendation is part of a reference manual for the language. The language defined in this Recommendation partially overlaps features of the language included in Basic SDL 2010 in Recommendation ITU T Z.101 and used in Comprehensive SDL 2010 in Recommendation ITU T Z.102 and the features of Recommendation ITU T Z.103.

[**ITU-T Z.105 (revised) “Specification and Description Language - SDL-2010 combined with ASN.1 modules”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=14675) defines how Abstract Syntax Notation One (ASN.1) modules are usable in combination with Specification and Description Language 2010 (SDL-2010). This text replaces Recommendation ITU-T Z.105 (2003) to align with Recommendations ITU-T Z.100, ITU T Z.101, ITU-T Z.102, ITU-T Z.103, ITU-T Z.104, ITU T Z.106 and ITU T Z.107 for SDL 2010. Recommendation ITU-T Z.105 (2003) replaced the semantic mappings from ASN.1 to SDL 2000 defined in Recommendation ITU-T Z.105 (1999). The use of ASN.1 notation embedded in the Specification and Description Language previously defined in Recommendation ITU-T Z.107 (1999) is not defined by this Recommendation. The main area of application of this Recommendation is the specification of telecommunication systems. The combined use of SDL-2010 and ASN.1 permits a coherent way to specify the structure and behaviour of telecommunication systems, together with data, messages and encoding of messages that these systems use. This version of Recommendation ITU-T Z.105 includes necessary alignments with ASN.1:2002 Recommendations, mapping of XML values, improved mapping of bit string values and mapping of relevant ASN.1 constructs for extensions.

[**ITU-T Z.106 (revised) “Specification and Description Language - Common interchange format for SDL-2010”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=14676) defines the common interchange format of Specification and Description Language (SDL CIF). The SDL CIF is intended for the interchange of graphical SDL 2010 specifications (SDL GR) made on different tools that do not use the same storage format. Prior to the definition of SDL CIF, the textual phrase representation of SDL-2010 (SDL PR) was used to interchange specifications with the disadvantage that all graphical information was lost, making the same specifications often look very dissimilar in different environments. With the SDL CIF, this disadvantage is reduced to a minimum, as it contains most of the graphical information. The SDL CIF improves the independence from specific tool vendors and allows standards bodies to accept specifications in SDL CIF irrespective of the tool they use for their internal work. This also improves productivity by allowing specifications to be made on the accustomed tool. All SDL 2010 tool vendors are encouraged to provide facilities for importing and exporting SDL CIF.

This Recommendation defines how SDL 2010 descriptions are stored in order to be interchanged between tools coming from different vendors. It does not take into account the message sequence chart (MSC) notation. SDL CIF is an optional part of SDL-2010. SDL CIF is based on the SDL PR syntax, the textual phrase representation of SDL 2010 also defined in this Recommendation. SDL CIF is readable and written by tools as well as users. All the constructs available in SDL 2010 are able to be expressed in graphical form or in the purely textual SDL PR form. Constraints on graphical presentation are expressed in SDL CIF by adding specific annotations to SDL PR. As a result, most SDL PR descriptions are legal SDL CIF descriptions. SDL CIF is an open storage format as it includes a mechanism of tool-specific directives. This mechanism allows an SDL CIF compliant tool to extend the format by adding specific information. SDL CIF is also easily implemented and provides tool vendors with two levels of tool conformance and concepts of mandatory and optional directives.

SDL PR is an alternative text-only syntax for the Specification and Description Language. Before 2002, SDL PR was published as part of ITU-T Z.100, but as the main use of this notation is for communication within and between tools the definition has been moved to this Recommendation. SDL PR is Level 0 SDL CIF and allows the interchange of syntactically complete SDL-2010 descriptions, usually as a single file per system. Conformance to SDL PR requires the model to conform to the corresponding semantics defined in Recommendations ITU T Z.101, ITU T Z.102, ITU T Z.103, ITU T Z.104, ITU T Z.105 and ITU T Z.107.

This Recommendation introduces two further levels of SDL CIF. Two further conformance levels are defined, one at a more liberal SDL PR level and the second including graphical information. The complete grammar is described with the related semantics. Mandatory and optional directives are described, as well as the format for tool-specific directives. Current tool-specific directives are described in Appendix I.

[**ITU-T Z.107 (revised) “Specification and Description Language - Object-oriented data in SDL-2010”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=14677) defines the object-oriented data features of the Specification and Description Language building on the foundation of the data definitions and expressions defined in Recommendation ITU T Z.104. Together with Recommendations ITU T Z.100, ITU T Z.101, ITU T Z.102, ITU T Z.103, ITU T Z.104, ITU T Z.105 and ITU T Z.106, this Recommendation is part of a reference manual for the language. The language defined in this Recommendation partially overlaps features of the language included in Basic SDL 2010 in Recommendation ITU T Z.101 and used in Comprehensive SDL 2010 in Recommendation ITU T Z.102, and the features of Recommendations ITU T Z.103 and ITU-T Z.104.

**ITU-T Z.161 (revised) “Testing and Test Control Notation version 3: TTCN-3 core language” (under approval)** defines Testing and Test Control Notation 3 (TTCN-3) intended for specification of test suites that are independent of platforms, test methods, protocol layers and protocols. TTCN-3 can be used for specification of all types of reactive system tests over a variety of communication ports. Typical areas of application are protocol testing (including mobile and Internet protocols), service testing (including supplementary services), module testing, testing of Common Object Request Broker Architecture (CORBA) based platforms and application programming interfaces (APIs). The specification of test suites for physical layer protocols is outside the scope of this Recommendation. This revision of the Recommendation contains amendments, clarifications, corrigenda and editorial corrections.

**ITU-T Z.161.2 (revised) “Testing and Test Control Notation version 3: TTCN-3 language extensions: Configuration and deployment support” (under approval)** defines the configuration and deployment support package of TTCN-3. TTCN-3 can be used for the specification of all types of reactive system tests over a variety of communication ports. Typical areas of application are protocol testing (including mobile and Internet protocols), service testing (including supplementary services), module testing, testing of Common Object Request Broker Architecture (CORBA) based platforms, application programming interfaces (APIs), etc. TTCN-3 is not restricted to conformance testing and can be used for many other kinds of testing including interoperability, robustness, regression, system and integration testing. The specification of test suites for physical layer protocols is outside the scope of this Recommendation.

**ITU-T Z.161.3 (revised) “Testing and Test Control Notation version 3: TTCN-3 language extensions: Advanced parameterization” (under approval)** defines the advanced parameterization package of TTCN-3. TTCN 3 can be used for the specification of all types of reactive system tests over a variety of communication ports. Typical areas of application are protocol testing (including mobile and Internet protocols), service testing (including supplementary services), module testing, testing of Common Object Request Broker Architecture (CORBA) based platforms, application programming interfaces (APIs), etc. TTCN-3 is not restricted to conformance testing and can be used for many other kinds of testing including interoperability, robustness, regression, system and integration testing. The specification of test suites for physical layer protocols is outside the scope of this Recommendation.

**ITU-T Z.161.4 (revised) “Testing and Test Control Notation version 3: TTCN-3 language extensions: Behaviour types” (under approval)** defines the behaviour types package of TTCN 3. TTCN 3 can be used for the specification of all types of reactive system tests over a variety of communication ports. Typical areas of application are protocol testing (including mobile and Internet protocols), service testing (including supplementary services), module testing, testing of Common Object Request Broker Architecture (CORBA) based platforms, application programming interfaces (APIs), etc. TTCN 3 is not restricted to conformance testing and can be used for many other kinds of testing including interoperability, robustness, regression, system and integration testing. The specification of test suites for physical layer protocols is outside the scope of this Recommendation.

**ITU-T Z.161.7 (revised) “Testing and Test Control Notation version 3: TTCN-3 language extensions: Object-Oriented Features” (under approval)** defines the support for object-oriented features in TTCN-3. TTCN-3 can be used for the specification of all types of reactive system tests over a variety of communication ports. Typical areas of application are protocol testing (including mobile and Internet protocols), service testing (including supplementary services), module testing, testing of OMG CORBA based platforms, APIs, etc. TTCN-3 is not restricted to conformance testing and can be used for many other kinds of testing including interoperability, robustness, regression, system and integration testing. The specification of test suites for physical layer protocols is outside the scope of the present document.

**ITU-T Z.167 (revised) “Testing and Test Control Notation version 3: Using ASN.1 with TTCN-3” (under approval)** defines a normative way of using ASN.1 as defined in Recommendations ITU-T X.680, ITU-T X.681, ITU-T X.682 and ITU-T X.683 with TTCN-3. The harmonization of other languages with TTCN-3 is not covered by this Recommendation. This revision of the Recommendation contains amendments, clarifications, corrigenda and editorial corrections.

**ITU-T Z.168 (revised) “Testing and Test Control Notation version 3: The IDL to TTCN-3 mapping” (under approval)** defines the mapping rules for Common Object Request Broker Architecture (CORBA) Interface Definition Language (IDL) to TTCN-3 (as defined in Recommendation ITU-T Z.161) to enable testing of CORBA-based systems. The principles of mapping CORBA IDL to TTCN-3 can be also used for the mapping of interface specification languages of other object /component-based technologies. The specification of other mappings is outside the scope of this Recommendation. This revision of the Recommendation contains amendments, clarifications, corrigenda and editorial corrections.

**ITU-T Z.169 (revised) “Testing and Test Control Notation version 3: Using XML schema with TTCN-3” (under approval)** defines the mapping rules for the world wide web consortium (W3C) schema to Testing and Test Control Notation 3 (TTCN-3) to enable testing of XML-based systems, interfaces and protocols. This revision of the Recommendation contains amendments, clarifications, corrigenda and editorial corrections.

**ITU-T Z.171 (revised) “Testing and Test Control Notation version 3: Using JSON with TTCN-3” (under approval)** specifies the rules to define schemas for JSON data structures in TTCN 3, to enable testing of JSON-based systems, interfaces and protocols, and the conversion rules between TTCN-3 and JSON to enable exchanging TTCN 3 data in JSON format between different systems.

[**ITU-T Z.100 Implementer's guide “Specification and Description Language implementer's guide – Version 4.0.1”**](https://www.itu.int/rec/T-REC-Z.Imp100-202104-I)**:** The purpose of this implementer's guide is to compile reported defects with resolutions and other agreed changes for the ITU T Specification and Description Language related ITU T Recommendations (Z.100, Z.101, Z.102, Z.103, Z.104, Z.105, Z.106, Z.107, Z.109, Z.111 and Z.119) prior to these changes being published in approved Recommendations. This implementer's guide includes all changes agreed by Q12/17 to the texts of the relevant Recommendations consented or in-force at the date the guide is approved by SG17 and applies until either the implementer's guide is updated to following version or all the changes are incorporated into the relevant Recommendations and the implementer's guide is updated to a later version. It is assumed that consented Recommendations will subsequently be approved.

I.14 Rules and Procedures, Working Methods

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