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| **TSAG** |
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| **关键词：** | 标准化；研究组；活动报告；主要成果 |
| **摘要：** | 本报告总结了2018年2月至2019年8月ITU-T标准化工作取得的进展，以及电信标准化局为加强ITU-T标准化平台所采取的措施。 |

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# 内容提要

ITU-T标准化工作成就摘要

2018年10月1日至2019年8月31日，国际电联批准了300多份项新的和经修订的ITU-T建议书。附录一列出了这些ITU-T建议书及相关案文并概述了其内容。

有关IMT-2020（5G）传输的各个项目势头强劲。由ITU-T进行标准制定工作的相关技术包括无源光网络（PON）、运营商级以太网和光传输网（OTN），它们都具有支持5G系统的极大潜力。

国际电联的一项新标准为将机器学习经济高效集成入5G和未来网络奠定了基础。该标准描述了网络的架构框架，以提供当前和未来使用机器学习的案例。

国际电联一项新的室内高速“可见光通信”（VLC）标准，亦称“LiFi”，将为VLC市场的增长奠定基础。该标准是通信连接和照明产业合作的基础。

国际电联关键标准的修订版提供了可实现多供应商互操作的100G密集波分复用（DWDM）相干线路接口。这些标准接口将加速行业创新，以扩大城域网络的容量。

国际电联的新标准旨在为农村社区提供高速宽带服务，其光缆重量轻、能够提供太比特光缆，可以部署于地表，费用低且环境影响最小。

国际电联的一项新标准为评估移动电话的环境影响制定了标准。国际电联的另一项新标准为电子废物回收者提供了指导方针和认证方案。

两项新的国际电联标准旨在克服密码的安全限制，研究解决移动设备上的生物认证和使用外部认证器（如移动设备）对Web用户进行认证。将上述两项标准提交国际电联的提交人为 FIDO（“在线快速身份识别”）联盟。

国际电联的两项新标准旨在处理语音服务质量（QoS）和4G电路交换回退之间的关系，以及移动网络服务质量测量的最佳实践。国际电联修订标准详细说明了影响4G话音端到端服务质量的因素。支持高质量语音的电子模型现在可以同时处理宽带（50-7000 Hz）和全频带（20-20000赫兹）。

国际电联有三项新标准负责处理国际通信相关的经济和政策问题，特别是网络运营商与过顶（OTT）服务提供商之间的关系、移动金融服务竞争以及用于交换电话业务的、关于价格/资费/费率列表统一格式的原则。

国际电联的一项新标准描述了打击假冒信息通信技术设备的解决方案框架，提供了在部署打击假冒信息通信技术设备流通和使用的解决方案时要考虑的参考框架和要求。

国际电联建立了一个新的标准数据库，以协助统一智能交通系统（ITS）的标准。该数据库包括所有相关标准机构制定的智能交通系统标准，为支持联网车辆和自动驾驶的所有标准提供参考。

三个ITU-T焦点小组的活动已经结束。ITU-T“支持物联网和智慧城市与社区的数据处理和管理”焦点组的交付成果又提交ITU-T SG20。ITU-T关于“包括数字法定货币在内的数字货币”和“分布式分类账技术的应用”焦点组的交付成果已提交本次电信标准化顾问组（TSAG）会议审议。

为些提供支持的协作

国际电联和斯坦福大学（国际电联新的学术界成员）已同意建立伙伴关系，支持由中央银行授权和发行的数字法定货币进行试点。该伙伴关系是为响应ITU-T“数字货币，包括数字法定货币”焦点组与会者关于建立一个新论坛继续开展工作的呼吁。

全球超过100个城市正在使用基于国际电联标准的“可持续智慧城市关键绩效指标”（由“[共建可持续智慧城市（U4SSC）举措](https://www.itu.int/en/ITU-T/ssc/united/Pages/default.aspx)”推动的指标）衡量其进展。国际电联的案例研究使用关键绩效指标评估了迪拜、新加坡和莫斯科智能城市项目取得的进展。

[新的国际电联 – 世界卫生组织安全收听工具包](https://itu.int/go/safelistening/toolkit)为采用国际电联关于安全收听“个人或便携音频系统”（特别是音乐播放器）的标准提供了实用指南，以支持世界卫生组织提出的“让收听安全”举措。此外，国际电联的新标准为个人声音放大器制定安全收听指南。

ITU-T已经敲定了[国家标准化秘书处（NSS）的新准则](https://www.itu.int/en/ITU-T/gap/Documents/nss-rep-may.pdf)，同时考虑到成员对2014年首次发布准则的反馈意见。新准则为制定国家程序和进程提供了若干选择，以支持有效参与国际电联电信标准的制定进程。该准则是作为[国际电联弥合标准化差距（BSG）方案](https://www.itu.int/en/ITU-T/gap/Pages/default.aspx)的一部分制定的。

2019年5月17日，国际电联在日内瓦总部为[世界电信和信息社会日（WTISD）](https://news.itu.int/itu-celebrates-world-telecommunication-and-information-society-day/)举办庆祝活动。2019年WTISD的主题是“弥合标准化差距”。WTISD庆祝活动的特色是就包容性国际标准对数字卫生、数字金融普惠以及智能城市和社区的重要性进行小组讨论。六名获奖者因对国际电联弥合标准化差距工作做出重大贡献而获得表彰。

2019年5月28日至31日在日内瓦举行的第三届[人工智能惠及人类全球峰会](https://aiforgood.itu.int/)催生“人工智能共享区”：旨在实现全球影响的协作框架。人工智能共享区将助力人工智能的开发和应用，以建立最先进的人工智能解决方案，并在共享数据集、测试和模拟环境、人工智能模型和相关软件以及存储和计算资源的帮助下形成规模。

[金融包容性全球举措（FIGI）](https://www.itu.int/en/ITU-T/extcoop/figisymposium/Pages/default.aspx)由国际电联、世界银行集团和支付和市场基础设施委员会牵头，并得到比尔和梅琳达•盖茨基金会的资金支持，是一项为期三年的、为推进数字金融研究并加快发展中国家数字普惠金融步伐的集体行动方案。

阿根廷[国立理工大学](https://www.frsf.utn.edu.ar/)于2018年11月26-28日在圣达菲举行第10届[大视野2018：面向5G未来的机器学习](https://www.itu.int/en/ITU-T/academia/kaleidoscope/2018/Pages/default.aspx)研讨会。获奖论文由日本国家信息和通信技术研究所的研究人员撰写，重点介绍了机器学习支持自动网络切片的潜力。

《国际电联期刊》的一期专刊以“[数据惠及人类](https://www.itu.int/en/journal/002/Pages/default.aspx)”为主题，发表了原创学术论文，研究有效数据管理和分析背后的技术、业务和政策挑战。即将发行的特刊将讨论无线电波传播以及视频和沉浸式媒体的未来。

国际电联标准化平台

ITU-T成员2019年保持强劲增长，自2018年12月以来净增加了22个成员的（不包括学术成员）。在此期间，14个部门成员和26个部门准成员加入了ITU-T，共计40个新成员。此外，16个新学术界成员的加入，使学术成员数量净增4个。ITU-T新成员包括能源和公用事业、航运和物流、移动支付、过顶应用、汽车、物联网/M2M连接、分布式分类账技术、量子通信、网络安全、人工智能以及服务质量和体验领域的公司。

ITU-T欢迎量子通信领域的一批新成员加盟。这些新成员加入国际电联，旨在对基于量子物理特性的国际电联量子信息技术安全和网络标准的发展施加影响。

ITU-T第5、11、16和20研究组组实施了一个试点项目，以增加中小企业对国际电联工作的参与。作为试点项目的一部分，16家中小企业参加ITU-T已获得其相关主管部门的批准。

“[ICT产品一致性数据库](http://www.itu.int/net/itu-t/cdb/ConformityDB.aspx)”使业界能够宣传ICT产品和服务与ITU-T建议书的一致性，帮助用户选择符合标准的产品。该数据库包括电子卫生产品、与车载免提终端兼容的移动电话、以太网、IPTV和移动号码便携。

职员多元化、性别平等和女性赋权依然是电信标准化局的一项重点工作。过去两年，电信标准化局60%的升职机遇授予了专业职类的女性员工。电信标准化局批准了联合国欧洲经济委员会（UNECE）的“促进性别平等的标准”举措，以加强标准制定中的性别平衡，确保标准的内容和实施有助于实现性别平等。

电信标准化局支持实现欧盟战略计划的目标T.5“扩大并促进与国际、区域和国家标准化机构的合作”，其采用的方式为继续推动ITU-T参与其他机构安排的活动，以促进其他机构参与ITU-T工作组、讲习班和相关ITU-T协作举措。

[MyWorkspace](https://www.itu.int/net4/ITU-T/myworkspace/)第3版已经发布，开发了基于初始用户反馈的新功能。MyWorkspace是面向TIES用户的全新个性化网页，用户可轻松获取ITU-T代表最重视的信息和服务。[搜索引擎](https://www.itu.int/net4/ITU-T/search/Landing)反馈来自全部国际电联文件、出版物和网页的结果。ITU-T研究组的SharePoint协作网站不断得到增强。新的服务通告新闻频道<http://tsbtech.itu.int/>定期向ITU-T代表提供有关新服务和工具改进的最新信息。

2018年10月至2019年8月，出版了超过14,000的ITU-T建议书及增补。除通常的PDF格式外，主要版的建议书及增补正在使用可重排版的ePub格式出版（即文件可根据输出设备调整其表现形式）。国际电联产品“ITU-T建议书和选定手册”继续使用USB密钥按季度分发。

电信标准化局继续将以传统批准程序（TAP）批准的建议书以及所有TSAG报告翻译成国际电联的所有正式语文。电信标准化局根据先前从ITU-T研究组和语言组接到的要求，在划拨的翻译预算范围内，在报告期翻译了24份AAP建议书。

国际电联讲习班和专题研讨会讨论标准化方面不断涌现的新趋势，提高ITU-T工作的知名度，加强ITU-T与其他机构的协作，吸引和招募新的ITU-T成员，并鼓励在国际标准的制定和实施方面开展同行互学。在本报告期间，组织了50多次国际电联讲习班和专题讨论会。

# Annex – Full Report of activities in ITU-T (from October 2018 to August 2019)

# 1 Selection of achievements in ITU-T standardization

ITU approved more than 300 new and revised ITU-T Recommendations from 1 October 2018 to 31 August 2019. Appendix I lists these ITU-T Recommendations and related texts and summarizes their contents.

Executive summaries for the various ITU-T Study Group meetings can be found on the homepages of [ITU-T Study Groups](https://www.itu.int/en/ITU-T/studygroups/Pages/default.aspx). Summaries of meetings held during the reporting period are listed below.

* ITU-T Study Group 2 (Operational aspects): [Meeting report, February 2019](https://www.itu.int/md/meetingdoc.asp?lang=en&parent=T17-SG02-R-0012)
* ITU-T Study Group 3 (Economic and policy issues): [Executive summary, April 2019](https://www.itu.int/en/ITU-T/studygroups/2017-2020/03/Documents/SG3%20Executive%20Summary%202019.pdf)
* ITU-T Study Group 5 (Environment and circular economy): [Executive summary, May 2019](https://www.itu.int/en/ITU-T/studygroups/2017-2020/05/Pages/exec-sum.aspx)
* ITU-T Study Group 9 (Broadband cable and TV): [Executive summary, May 2019](https://www.itu.int/en/ITU-T/studygroups/2017-2020/09/Documents/Executive-summary-2017-05-Hangzhou.pdf)
* ITU-T Study Group 11 (Protocols and test specifications): [Executive summary, March 2019](https://www.itu.int/en/ITU-T/studygroups/2017-2020/11/Pages/exec-sum-201903.aspx)
* ITU-T Study Group 12 (Performance, QoS and QoE): [Executive summary, May 2019](https://www.itu.int/en/ITU-T/studygroups/2017-2020/12/Pages/1905-summary.aspx); [Executive summary, November 2018](https://www.itu.int/en/ITU-T/studygroups/2017-2020/12/Pages/1811-summary.aspx)
* ITU-T Study Group 13 (Future networks and cloud): [Executive summary, March 2019](https://www.itu.int/en/ITU-T/studygroups/2017-2020/13/Pages/exec-sum.aspx)
* ITU-T Study Group 15 (Transport, access and home): [Executive summary, July 2019](https://www.itu.int/en/ITU-T/studygroups/2017-2020/15/Pages/exec-sum.aspx); [Executive summary, October 2018](https://www.itu.int/en/ITU-T/studygroups/2017-2020/15/Pages/exec-sum-201810.aspx)
* ITU-T Study Group 16 (Multimedia): [WP2/16 executive summary, June 2019](https://www.itu.int/en/ITU-T/studygroups/2017-2020/16/Pages/results-1906.aspx); [Executive summary, March 2019](https://www.itu.int/en/ITU-T/studygroups/2017-2020/16/Pages/results-1903.aspx); [WP 1/16 executive summary, October 2018](https://www.itu.int/en/ITU-T/studygroups/2017-2020/16/Pages/results-1810.aspx)
* ITU-T Study Group 17 (Security): [Executive summary, January 2019](https://www.itu.int/en/ITU-T/studygroups/2017-2020/17/Pages/1901-summary.aspx)
* ITU-T Study Group 20 (IoT and smart cities): [Executive summary, April 2019](https://www.itu.int/en/ITU-T/studygroups/2017-2020/20/Pages/exec-sum-april19.aspx); [Executive summary, December 2018](https://www.itu.int/en/ITU-T/studygroups/2017-2020/20/Pages/exec-sum-dec18.aspx)

IMT-2020 (5G) transport projects have built strong momentum. Passive Optical Network (PON), Carrier Ethernet and Optical Transport Network (OTN) are among the technologies standardized by ITU-T with significant potential to support 5G systems. An ITU-T Technical Report places emerging 5G radio requirements in the context of their demands on transport networks. The latest ITU-T text to address 5G transport is a Supplement highlighting the requirement of 5G fronthaul in a PON context.

* [ITU brings new clarity to 5G transport](https://news.itu.int/5g-transport-new-clarity/)

A new ITU standard has established a basis for the cost-effective integration of Machine Learning into 5G and future networks. The standard describes an architectural framework for networks to accommodate current as well as future use cases of Machine Learning. The approval marks the first time that a Study Group has approved a Focus Group deliverable as an ITU standard before the conclusion of the Focus Group’s lifetime, representing an important achievement in ITU’s work to expedite the transition from exploratory studies to the agreement of new ITU standards.

* [New ITU standard to introduce Machine Learning into 5G networks](https://news.itu.int/new-itu-standard-machine-learning-5g-networks/)

A new ITU standard for high-speed indoor ‘visible light communication’ (VLC), also known as ‘LiFi’, will establish the foundations for the growth of the VLC market. LED and infrared are capable of transmitting data at rates high enough to support bandwidth-intensive services such as video streaming, interactive gaming and advanced virtual reality (VR) applications. VLC is also expected to assist in unlocking the potentially multi-billion dollar indoor-positioning market by achieving positioning accuracy superior to that achieved by WiFi.

* [High-speed indoor Visible Light Communication: New ITU standard nearing approval](https://news.itu.int/new-standard-visible-light-communication/)

A revision of a key ITU standard provides for multi-vendor interoperable 100G DWDM coherent line interfaces. The standard interfaces will accelerate industry innovation to achieve greater capacity in metro networks. The achievement of a standard for multi-vendor interoperability represents an industry first, particularly with respect to the adaption of the ‘error vector magnitude’ metric from wireless communications to optical transport. ITU-T as started validating the ‘error vector magnitude’ metric for 16QAM modulation with a view to standardizing 400G line interfaces.

* [ITU delivers the first multi-vendor interoperable 100G coherent line interfaces](https://news.itu.int/first-multi-vendor-interoperable-100g-coherent-line-interfaces/)

New ITU standards aim to bring high-speed broadband services to rural communities with lightweight, terabit-capable optical cable that can be deployed on the ground’s surface with minimal expense and environmental impact. The standards are giving developing countries the confidence to consider the rollout of optical networks in some of the world’s most challenging conditions. Nepal, for example, has highlighted its intention to use ITU-standardized lightweight optical cable to connect places as remote as Mount Everest Base Camp and Annapurna Trekking Trail.

* [New ITU standards bring broadband to places as remote as Mount Everest](https://news.itu.int/new-standards-broadband-mount-everest/)

More than 100 cities worldwide are measuring their progress using ‘Key Performance Indicators for Smart Sustainable Cities’ based on ITU standards, indicators promoted by the ‘United for Smart Sustainable Cities (U4SSC) initiative’. ITU-T standardization work for the Internet of Things (IoT) and smart cities aims to support interoperability and efficient data processing and management. The standardization of IoT test specifications is accelerating, supported by the increasing collaboration of ITU-T and oneM2M.

* [New ITU case study maps the Moscow ‘smart city’ journey](https://www.itu.int/en/mediacentre/Pages/2018-PR34.aspx)

A new ITU standard provides criteria for the evaluation of the environmental impact of mobile phones. The standard considers all stages of a mobile phone’s lifecycle, including end-of-life management. It also defines a minimum level of environmental performance. Another new ITU standard provides guidelines and certification schemes for e-waste recyclers. It addresses in particular the role played by the informal sector in e-waste collection and dismantling.

* [Progress update on ITU standardization for environment and circular economy](https://www.itu.int/en/ITU-T/studygroups/2017-2020/05/Pages/exec-sum.aspx)

Two new ITU standards aim to overcome the security limitations of passwords, addressing biometric authentication on mobile devices and the use of external authenticators, such as mobile devices, to authenticate Web users. The specifications were submitted to ITU by the FIDO Alliance (‘Fast Identity Online’), an industry consortium focused on developing open specifications for interoperable strong user authentication leveraging public key cryptography. The approval of the FIDO specifications as ITU international standards is expected to stimulate their adoption globally.

* [New ITU standards to overcome the security limitations of passwords](https://news.itu.int/new-itu-standards-to-overcome-the-security-limitations-of-passwords/)
* [Time to eliminate the password: New report on next-generation authentication for digital financial services](https://news.itu.int/new-report-next-generation-authentication/)

The new ITU-WHO Safe Listening Toolkit provides practical guidance relevant to the adoption of the ITU standard on the safe listening of 'personal or portable audio systems' (particularly music players), in support of the WHO ‘Make Listening Safe’ initiative. The standard and associated toolkit aim to prevent audio devices from causing ‘sound-induced hearing loss’, the world’s leading cause of preventable hearing loss. In addition, a new ITU standard provides safe listening guidelines for personal sound amplifiers. Future standards in the series are expected to address communications and assistive devices as well as gaming consoles.

* [ITU and WHO launch ‘safe listening’ toolkit to protect people’s hearing](https://news.itu.int/celebrating-power-music-and-safe-listening-itu-who/)

ITU has established a [new standards database](https://www.itu.int/net4/ITU-T/landscape#?topic=0.131&workgroup=1&searchValue=&page=1&sort=Revelance) to assist the harmonization of standards for intelligent transport systems (ITS). The database includes ITS standards developed by all relevant standards bodies, providing a reference to all standards supporting connected vehicles and automated driving. The database supports the Collaboration on ITS Communication Standards (CITS) in its work to ensure coherence and compatibility among ITS standards, an objective growing in importance as the deployment of ITS solutions accelerates worldwide.

* [New ITU database to assist the harmonization of intelligent transport standards](https://news.itu.int/database-harmonizing-intelligent-transport-standards/)

Two new ITU standards address the relationship between voice QoS and 4G circuit-switched fallback, and best practices for the measurement of QoS in mobile networks. Revisions have been made to the ITU standard detailing the factors influencing end-to-end QoS for 4G voice. The E-Model – a computational model to support transmission planners in ensuring high-quality voice services – now addresses both wideband (50-7000 Hz) and fullband (20-20000 Hz).

* [Webinar: ITU standards to measure IP performance and 4G voice quality](https://news.itu.int/webinar-itu-standards-measure-ip-performance-4g-voice-quality/)

ITU-T has welcomed a range of new members in the field of quantum communications. These new members aim to influence development of ITU standards on security and network aspects of quantum information technologies, technologies based on the properties of quantum physics. These standards will be key to the deployment of quantum information technologies and their interoperability. The ecosystem of quantum specialists within ITU continues to expand, and ITU aims to play a leading role leading role in bringing standards bodies together to ensure the effective coordination of quantum-relevant standardization activities.

* [Quantum specialists are racing to join the ITU membership: ID Quantique explains why](https://news.itu.int/why-quantum-specialists-join-itu/)
* [How can quantum technologies make networking more secure? ITU workshop in Shanghai](https://news.itu.int/how-can-quantum-technologies-make-networking-more-secure-itu-workshop-in-shanghai/)
* [CTOs from China, Japan and Korea highlight standardization priorities](https://news.itu.int/ctos-china-japan-korea-highlight-standardization-priorities/)

ITU and Stanford University, a new ITU Academia member, have agreed to launch a partnership to support pilot implementations of Digital Fiat Currency (DFC). The partnership will offer technical assistance to Central Banks piloting the introduction of DFC and an open forum to share lessons learnt from these pilots among Central Banks, digital currency platform providers, payment system organizations, academia, and telecoms companies. The initiative is expected to inform related international standardization work on the ITU platform. The International Monetary Fund and Bank for International Settlements are also expected to join this initiative.

* [ITU and Stanford University to launch new partnership supporting pilots of Digital Fiat Currency](https://news.itu.int/itu-stanford-university-launch-new-partnership-supporting-pilots-digital-fiat-currency/)

Three new ITU standards address economic and policy issues relevant to international communications, in particular the relationship between network operators and providers of over-the-top (OTT) services, competition in mobile financial services, and principles for a unified format of price/tariffs/rates-lists used for exchanging telephone traffic. The new ITU standard on OTTs describes the interdependence of OTT and telecoms business, highlighting that the coexistence of OTT and telecoms, and their complementary contributions to innovation and investment, will be central to the advance of the ICT ecosystem.

* [New ITU Recommendation provides parameters for a collaborative framework for OTTs](https://news.itu.int/new-itu-recommendation-provides-parameters-for-a-collaborative-framework-for-otts/)

A new ITU standard describes a framework for solutions to combat counterfeit ICT devices, providing the reference framework and requirements to be considered when deploying solutions to combat the circulation and use of counterfeit ICT devices. This area of work continues to accelerate and has expanded to combat counterfeiting as well as the theft of mobile devices. Renewed emphasis has been placed on the need to concerns surrounding the tampering with or cloning of ICT device identifiers.

* [Progress update on ITU standardization for protocols, test specifications and combatting counterfeiting](https://www.itu.int/en/ITU-T/studygroups/2017-2020/11/Pages/exec-sum-201903.aspx)

Focus Groups are formed in response to immediate ICT standardization demands, tasked with establishing the basis for subsequent standardization work in ITU-T Study Groups. These groups are the place to explore new directions in ITU standardization.

Three ITU-T Focus Groups have concluded their activities**:**

* [Data Processing and Management to support IoT and Smart Cities & Communities](https://www.itu.int/en/ITU-T/focusgroups/dpm/Pages/default.aspx)
* [Digital Currency including Digital Fiat Currency](https://www.itu.int/en/ITU-T/focusgroups/dfc/Pages/default.aspx)
* [Application of Distributed Ledger Technology](https://www.itu.int/en/ITU-T/focusgroups/dlt/Pages/default.aspx)

Active ITU-T Focus Groups:

* [Artificial Intelligence for Health](https://www.itu.int/en/ITU-T/focusgroups/ai4h/Pages/default.aspx)
* [Machine Learning for Future Networks including 5G](https://www.itu.int/en/ITU-T/focusgroups/ml5g/Pages/default.aspx)
* [Vehicular Multimedia](https://www.itu.int/en/ITU-T/focusgroups/vm/Pages/default.aspx)
* [Technologies for Network 2030](https://www.itu.int/en/ITU-T/focusgroups/net2030/Pages/default.aspx)
* [Environmental Efficiency for Artificial Intelligence and other Emerging Technologies](https://www.itu.int/en/ITU-T/focusgroups/ai4ee/Pages/default.aspx)

# 2 Conformity, interoperability and testing

## 2.1 Conformity Assessment Steering Committee (CASC)

The main objective of ITU-T CASC is to set up criteria, rules and procedures to recognize Test Laboratories (TL) with competence in ITU-T Recommendation(s) and register these TLs in a list of ITU-recognized TLs. This effort is supported by a guideline "Testing laboratories recognition procedure" agreed by ITU-T SG11 in 2015. According to requests received from ITU members and ITU-T Study Groups, ITU-T CASC has established a list of ITU-T Recommendations (e.g., ITU-T P.1140, ITU-T P.1100 and P.1110, and ITU-T K.116) which may become subjects of future joint certification schemes.

ITU-T CASC is developing a joint ITU/IEC certification scheme in collaboration with IECEE. This service would be organized and arranged by IECEE based on the IECEE peer-assessment programme, leveraging ITU-T technical experts nominated by ITU-T CASC.

ITU-T CASC has requested all ITU-T Study Groups to propose ITU-T Recommendations with potential to become subjects of this future ITU/IEC joint certification scheme, taking into consideration market needs.

The relevant working group of the IECEE Certification Management Committee (IECEE CMC) has finalized an Operational Document (OD) titled "ICT Laboratory Recognition Service on ITU-T Recommendations". The OD was presented at the March 2019 meeting of ITU-T CASC. The OD is awaiting the approval of IECEE CMC. The approval of the OD would allow any TL (including non-ITU members) to apply for recognition as a TL with competence in ITU-T Recommendations.

In addition, ITU-T CASC is currently developing the guideline "ITU-T CASC collaboration procedure with IECEE for TL recognition service on ITU-T Recommendations". This document is expected to be finalized by October 2019.

ITU-T CASC has received two applications from candidates requesting to be appointed ITU-T technical experts with competence in certain ITU-T Recommendations under the responsibility of ITU-T SG2 and ITU-T SG5. In line with the approved guidelines for the appointment of such ITU-T technical experts, ITU-T CASC formed appointment teams to review the applications and provide related recommendations to ITU-T CASC.

ITU-T CASC has requested that all ITU-T Study Groups appoint focal points for their interaction with ITU-T CASC.

More details are available on the ITU-T CASC [web page](https://www.itu.int/en/ITU-T/studygroups/2013-2016/11/Pages/CASC.aspx).

## 2.2 ICT product conformity database

The "[ICT product conformity database](http://www.itu.int/net/itu-t/cdb/ConformityDB.aspx)" enables industry to publicize the conformance of ICT products and services to ITU-T Recommendations, assisting users in their efforts to select standards-compliant products. The database currently contains more than 500 entries. Five categories of products and services have been submitted to the database:

* **e-Health** solutions complying with the specifications of ITU-T H.810 "Interoperability design guidelines for personal health systems", a transposition of the Continua Design Guidelines. The testing procedures are specified in the ITU-T H.820-H.850 sub-series of Recommendations.
* **Mobile phones** compatible with Bluetooth-enabled vehicle hands-free terminals. This compatibility is determined in accordance with the 'Chapter 12 tests' ("Verification of the transmission performance of short-range wireless (SRW) transmission enabled phones") of ITU-T P.1100 and ITU-T P.1110.
* **Ethernet** products complying with ITU-T G.8011/Y.1307 "Ethernet Services Characteristics". This standard as well as the corresponding tests are based on the work of MEF (formerly called Metro Ethernet Forum).
* **IPTV systems** compatible with ITU-T H.721 "IPTV terminal devices: Basic model" and ITU-T H.702 "Accessibility profiles for IPTV systems", tested to [HSTP-CONF-H721](http://www.itu.int/pub/T-TUT-IPTV-2015-H721) and [HSTP-CONF-H702](http://www.itu.int/pub/T-TUT-IPTV-2017-H702).
* **Mobile Number Portability (MNP)** systems compatible with ITU-T Q.Supplement 4 "Number portability – Capability set 1 requirements for service provider portability (All call query and Onward routing)", tested to ITU-T Q.3905.

## 2.3 Testing Internet of Things

Following the October 2018 approval of ITU-T Q.4060 "The structure of the testing of heterogeneous Internet of Things gateways in a laboratory environment", a new subcategory of the Q.series was established: Q.4060-Q.4099 "Testing specifications for IMT-2020 and IoT".

Current work items on IoT testing include Q.39\_FW\_Test\_ID\_IoT "The framework of testing of identification systems used in IoT" and Q.FW\_IoT/Test "Framework for IoT Testing"

# 3 Accessible ITU-T meetings

ITU-T provides services such as sign-language interpretation and captioning, and financial support in some cases, to engage persons with disabilities in the ITU-T standardization process.

American Sign Language (ASL), British Sign Language (BSL) and real-time captioning were provided for Q26/16 during the SG16 meeting in March 2019; the Q26/16 Rapporteur Group meeting, 10-12 June 2019; and the [JCA-AHF](https://www.itu.int/en/ITU-T/jca/ahf/Pages/default.aspx) meeting on 11 June 2019.

Q26/16 and JCA-AHF also organized workshop sessions on "[Accessibility for Emerging Technologies](https://www.itu.int/net4/wsis/forum/2019/Agenda/ViewSession/147#intro)" and "[Telecom Relay Services](https://www.itu.int/net4/wsis/forum/2019/Agenda/ViewSession/171#intro)" on 8 April 2019 at the ICT Accessibility Day of the WSIS Forum 2019. International Sign (IS) interpretation was provided and sponsored by The Nippon Foundation (Japan).

# 4 Intellectual property rights

The [TSB Director's Ad Hoc Group on Intellectual Property Rights (IPR AHG)](http://www.itu.int/en/ITU-T/ipr/Pages/adhoc.aspx) continues its work to protect the integrity of the standards-development process by clarifying aspects of the [ITU-R/ITU-T/ISO/IEC Patent Policy and related Guidelines](http://www.itu.int/en/ITU-T/ipr/Pages/revpatent.aspx) – the Union's main tool to manage the challenges associated with the incorporation of patents in [ITU-T and ITU-R Recommendations](http://www.itu.int/en/ITU-T/publications/Pages/recs.aspx). IPR AHG met at ITU headquarters in Geneva, 28 January 2019, followed by a joint ITU-NGMN conference on licensing practices in 5G industry segments, 29-30 January 2019, and a meeting of the NGMN IPR Group, 31 January 2019. The meeting report can be found on the IPR AHG website at <https://itu.int/en/ITU-T/ipr/Pages/adhoc.aspx>. See relevant [ITU News story](https://news.itu.int/itu-ngmn-promoting-level-playing-field-5g-intellectual-property/).

# 5 ITU-T Focus Groups: Exploring new directions in ITU standardization

Focus Groups are formed in response to immediate ICT standardization demands, tasked with establishing the basis for subsequent standardization work in ITU-T Study Groups. These groups are the place to explore new directions in ITU standardization. Focus Groups are open to ITU members as well as organizations outside ITU's membership. These groups are afforded great flexibility in their chosen deliverables and working methods.

## 5.1 Data Processing and Management to support IoT and Smart Cities & Communities

The [ITU-T Focus Group on Data Processing and Management to support IoT and Smart Cities & Communities (FG DPM)](https://www.itu.int/en/ITU-T/focusgroups/dpm/Pages/default.aspx) – final meeting 15-19 July 2019 – developed several technical specifications and technical reports for data management, taking into consideration the activities currently undertaken by the various standards bodies. FG DPM studied and reviewed existing technologies, platforms, guidelines and standards for data processing and management, including data formats, in support of IoT and Smart Cities. FG DPM developed 15 deliverables, which have been submitted for the consideration of its parent group, ITU-T SG20. These deliverables are available on the FG DPM homepage.

## 5.2 Digital Currency including Digital Fiat Currency

The [ITU-T Focus Group Digital Currency including Digital Fiat Currency (FG DFC)](https://www.itu.int/en/ITU-T/focusgroups/dfc/Pages/default.aspx) – final meeting 12-14 June 2019 – provided a forum for dialogue among players in the banking, fintech and telecom sectors to share information and best practices and showcase innovations. The group developed seven deliverables highlighting requirements for reference architecture and security. These deliverables also describe the need for standards in support of digital currency authorized and issued by Central Banks. The deliverables have been submitted for the consideration of this TSAG meeting and are available on the FG DFC homepage.

ITU and Stanford University, a new ITU Academia member, have agreed to launch a partnership to support pilot implementations of DFC. The partnership responds to a call from the FG DFC participants for a new forum to continue their work. See relevant [ITU News story](https://news.itu.int/itu-stanford-university-launch-new-partnership-supporting-pilots-digital-fiat-currency/).

The partnership will offer technical assistance to Central Banks piloting the introduction of DFC and an open forum to share lessons learnt from these pilots among Central Banks, digital currency platform providers, payment system organizations, academia, and telecoms companies. The initiative is expected to inform related international standardization work on the ITU platform. The International Monetary Fund and Bank for International Settlements are also expected to join this initiative.

## 5.3 Application of Distributed Ledger Technology

The [ITU-T Focus Group on Application of Distributed Ledger Technology (FG DLT)](https://www.itu.int/en/ITU-T/focusgroups/dlt/Pages/default.aspx) – final meeting 29 July - 1 August 2019 – has delivered an 'assessment framework' to support efforts to understand the strengths and weaknesses of DLT platforms in different use cases. The group has also produced a high-level DLT architecture – a reference framework – detailing the key elements of a DLT platform. The Focus Group studied high-potential DLT use cases and DLT platforms said to meet the requirements of such use cases. These studies guided the Focus Group's abstraction of the common requirements necessary to describe a DLT architecture and associated assessment criteria. The eight deliverables developed by FG DLT have been submitted for the consideration of this TSAG meeting and are available on the FG DLT homepage.

## 5.4 Machine Learning for Future Networks including 5G

The [ITU-T Focus Group on Machine Learning for Future Networks including 5G (FG ML5G)](https://www.itu.int/en/ITU-T/focusgroups/ml5g/Pages/default.aspx) is proposing standardization strategies to assist machine learning in contributing to the efficiency of emerging 5G systems. The group is defining the requirements of machine learning as they relate to interfaces, protocols, algorithms, data formats and network architectures. One of the Focus Group's ambitions is to address the challenges surrounding the availability and quality of the data required to fuel machine learning algorithms.

A new ITU standard developed by the Focus Group has established a basis for the cost-effective integration of Machine Learning into 5G and future networks. [ITU-T Y.3172](https://www.itu.int/ITU-T/recommendations/rec.aspx?rec=13894&lang=en) describes an architectural framework for networks to accommodate current as well as future use cases of Machine Learning.

ITU Y.3172 was approved in June 2019 by the Focus Group’s parent group, ITU-T SG13. The approval marks the first time that a Study Group has approved a Focus Group deliverable as an ITU standard before the conclusion of the Focus Group’s lifetime, representing an important achievement in ITU’s work to expedite the transition from exploratory studies to the agreement of new ITU standards. See relevant [ITU News story](https://news.itu.int/new-itu-standard-machine-learning-5g-networks/).

## 5.5 Technologies for Network 2030

The [ITU-T Focus Group on Technologies for Network 2030 (FG NET-2030)](https://www.itu.int/en/ITU-T/focusgroups/net2030/Pages/default.aspx) is examining how emerging technologies can enhance network capabilities to meet the demands of 5G systems and future innovations. The group is studying new media, services and architectures to identify communication needs and use cases for the year 2030 and beyond. In focus are applications including augmented and virtual reality and holograms, and the group aims also respond to increasing user demand for time-sensitive applications in fields such as telemedicine and industrial automation.

In May 2019, the Focus Group put forward an initial vision for networks in the year 2030 with a white paper titled [“Network 2030 - A Blueprint of Technology, Applications and Market Drivers Towards the Year 2030 and Beyond](https://www.itu.int/en/ITU-T/focusgroups/net2030/Documents/White_Paper.pdf)”.

## 5.6 Artificial Intelligence for Health

The [ITU-T Focus Group on Artificial Intelligence for Health (FG AI4H)](https://www.itu.int/en/ITU-T/focusgroups/ai4h), driven in close collaboration by ITU and WHO, is working towards the establishment of a framework and associated processes for the performance benchmarking of ‘AI for Health’ algorithms. The group is currently working on 12 topic areas ("use cases") addressing health issues including breast cancer, neurodegenerative diseases, autism, vision loss, skin lesions, cardiovascular diseases, and venomous snakebites. A summary of the current status of the work was published in The Lancet – “[WHO and ITU establish benchmarking process for artificial intelligence in health](https://www.thelancet.com/journals/lancet/article/PIIS0140-6736%2819%2930762-7/fulltext?dgcid=raven_jbs_etoc_email)” –, a weekly peer-reviewed general medical journal which is among the world’s oldest, most prestigious and best known general medical journals.

## 5.7 Vehicular Multimedia

The [ITU-T Focus Group on Vehicular Multimedia (FG VM](https://www.itu.int/en/ITU-T/focusgroups/vm/Pages/default.aspx)) is investigating where international standards could support the global adoption of new ‘infotainment’ systems incorporating services such as Augmented Reality navigation, video streaming, and automated in-vehicle climate control. FG VM has documented innovative use cases of vehicular multimedia and their underlying technical requirements. In the second phase of its work, the group will propose the architecture, interfaces and protocols of the vehicular multimedia network.

## 5.8 Environmental Efficiency for Artificial Intelligence and other Emerging Technologies

The [ITU-T Focus Group on Environmental Efficiency for AI and other Emerging Technologies (FG AI4EE)](https://www.itu.int/en/ITU-T/focusgroups/ai4ee/Pages/default.aspx)  – scheduled to meet for the first time in Vienna, Austria, 15 October 2019 – will study environmental efficiency in the age of Artificial Intelligence, increasing automation, and smart manufacturing. The group's work is also expected to support ITU's ongoing studies of the environmental requirements of IMT-2020 (5G) systems. The Focus Group aims to provide guidance on the environmentally efficient operation of emerging technologies, as well as the influence of these technologies on the environmental efficiency of the broader ICT ecosystem. See relevant [ITU Press Release](https://www.itu.int/en/mediacentre/Pages/2019-PR08.aspx).

# 6 Collaboration in standardization

## 6.1 Coordination and cooperation among ITU Sectors

Collaboration with ITU-R and with ITU-D is a standing agenda point of TSAG, where TSAG examines existing methods and approaches to collaboration or cooperation with other sectors, with the view to encouraging ITU-T to work more collaboratively or cooperatively in a reciprocal manner, and review is performed on a regular basis based on information received.

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 Study Groups.

* IRG-AVA: Intersector Rapporteur Group Audiovisual Media Accessibility, amongst ITU-T SG9, ITU-T SG16 and ITU-R SG6.
* IRG-AVQA: Intersector Rapporteur Group Audiovisual Quality Assessment, amongst ITU-T SG12 and ITU-R SG6.
* IRG-IBB: Intersector Rapporteur Group Integrated Broadcast-Broadband, between 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 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.

A series of events on "The Future of TV", initiated by ITU-T SG9, are organized in collaboration by the three ITU Sectors and ITU Regional Offices. Three such events have been held to date:

* [ITU Workshop on the Future of Television for Europe](https://www.itu.int/en/ITU-T/studygroups/2017-2020/09/Pages/workshops.aspx), Geneva, Switzerland, 7 June 2019
* [ITU Workshop on the Future of TV for the Americas](https://www.itu.int/en/ITU-T/Workshops-and-Seminars/201811/Pages/default.aspx), Bogotá, Colombia, 26 November 2018
* [ITU Workshop on the Future of Cable TV](https://www.itu.int/en/ITU-D/Regional-Presence/Europe/Pages/Events/2018/FCTV/The-Future-of-Cable-TV.aspx), Geneva, Switzerland, 25-26 January 2018

Similar events will be held for the Asia-Pacific region in Guangzhou, China, 3 September 2019; and in 2020 for the Africas region.

## 6.2 Coordination and cooperation with the Regions and the Regional Offices

With the goal of improving coordination and increasing the efficiency of the overall operations, events and activities of the Sector and the Bureau, TSB organizes conference calls and face-to-face meetings on a regular basis with ITU’s Regional Offices.

This activity has led to significant improvements in the overall coordination of standardization operations, events and activities taking place in the Regions. It has contributed to greater awareness of ITU-T standardization activities in each Region.

TSB will continue to enhance cooperation with the ITU Regional Offices, as well as with relevant regional and other international organizations dealing with standards.

## 6.3 General assistance and cooperation

ITU continues to provide leadership in building cooperation among the many interests served by ICT standardization.

The **World Standards Cooperation** is a partnership of ITU, ISO and IEC to promote international standards. The World Standards Cooperation leads the celebration of World Standards Day, 14 October. The theme of World Standards Day 2018 was "International Standards and the Fourth Industrial Revolution". The 2019 theme is “Video standards create a global stage”’.

**IEC, ISO and ITU** cooperate in standardization to the degree that 10 per cent of all ITU standards are common or aligned texts with the ISO/IEC Joint Technical Committee 1 on Information Technology (ISO/IEC JTC1).

**Global Standards Collaboration** **(GSC)** assists regional and international SDOs in coordinating their contributions to fields of mutual interest. [GSC-22](https://www.itu.int/en/ITU-T/gsc/22/Pages/default.aspx) was hosted by IEC and ISO on 26-27 March 2019 in Switzerland. ITU hosts the [repository](http://www.itu.int/en/ITU-T/gsc/Pages/meetings.aspx) of GSC documents from past meetings. See [GSC website](http://www.itu.int/en/ITU-T/gsc/Pages/default.aspx).

**ITU and the African Organization for Standardization (ARSO)** signed a [Cooperation Agreement](https://www.itu.int/en/ITU-T/extcoop/Documents/mou/ARSO-ITU.pdf) in June 2019, establishing a high-level, non-exclusive framework for cooperation. The agreement supports the promotion of ITU standards, taking into account the requirements of the African region, to support sustainable economic development and trade over the long term.

**ITU is a strong advocate of "Universal Design"** and has standardization guidelines to produce solutions that are inherently accessible to persons with and without disabilities.

**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.

**ITU's conformity and interoperability (C&I) programme** is of particular value to developing countries in their efforts to enhance conformity and interoperability of ICT products implementing ITU Recommendations or part thereof.

**Chief Technology Officer meetings**: [CTO and CxO meetings](http://www.itu.int/en/ITU-T/tsbdir/cto/Pages/default.aspx) bring together industry executives to highlight their business priorities and supporting standardization strategies. TSB management held a consultation meeting with CTOs from China, Japan and Korea in Tokyo, Japan, 16 July 2019, hosted by Japan’s Telecommunication Technology Committee. See relevant [ITU News story](https://news.itu.int/ctos-china-japan-korea-highlight-standardization-priorities/).

**AI for Good:** The AI for Good Global Summit series identifies practical applications of AI with the potential to accelerate progress towards the United Nations' Sustainable Development Goals. The third summit gave rise to ‘AI Commons’, a framework for collaboration to achieve global impact. The Commons will assist AI development and application in building on the state of the art, enabling AI solutions to scale with the help of shared datasets, testing and simulation environments, AI models and associated software, and storage and computing resources. See relevant [ITU News story](https://news.itu.int/introducing-ai-commons/).

**e-Health**: ITU-T continues its longstanding collaboration with bodies active in the healthcare field, supporting the development of medical-grade e-health devices. Participating organizations include UN bodies, standards bodies, academic and research institutes, and industry associations.

**Safe listening:** ITU-T and WHO continue to collaborate in support of the WHO "Make Listening Safe" initiative. ITU-T H.870 "Guidelines for safe listening devices/systems" was the first standard to result from this collaboration, focusing on the safe listening of 'personal or portable audio systems', particularly music players. The new ITU-T H.871 "Safe listening guidelines for personal sound amplifiers" provides guidance based on ITU-T H.870 to ensure safe sound levels and exposures for this new class of consumer device. Future standards in the series are expected to address communications and assistive devices as well as gaming consoles.

**Intelligent transport systems (ITS)**: The [Collaboration on ITS Communication Standards](http://www.itu.int/en/ITU-T/extcoop/cits/Pages/default.aspx) is a body responsible for the coordination of technical standardization work to encourage the offer of interoperable ITS products. CITS meetings are held back-to-back with ITU workshops on intelligent transport systems. CITS has established a [new standards database](https://www.itu.int/net4/ITU-T/landscape#?topic=0.131&workgroup=1&searchValue=&page=1&sort=Revelance) to assist the harmonization of ITS standards. The database includes ITS standards developed by all relevant standards bodies. See relevant [ITU News story](https://news.itu.int/database-harmonizing-intelligent-transport-standards/).

**ITU/WMO/UNESCO-IOC Joint Task Force on SMART Cable Systems:** The joint task force is leading an ambitious project to equip submarine communications cables with scientific sensors (e.g., sea water temperature, pressure, water movement) that could be used for climate change monitoring and tsunami early warning (“SMART cables”). SMART cables are technically and financially feasible and expected to be field-proven via ongoing demonstrations and proposed pilot systems in The Americas, Antarctica, Asia and Europe. On 2 August 2019, the joint task force published a detailed peer-reviewed article in the journal “Frontiers in Marine Science”: “[SMART Cables for Observing the Global Ocean: Science and Implementation](https://www.frontiersin.org/articles/10.3389/fmars.2019.00424/full)”.

**ICT, environment and climate change**: ITU-T maintains cooperation with a wide range of bodies active in environmental sustainability, including UN bodies, standards bodies, regional organizations, academia, and industry associations. ITU is working together with nine other UN bodies to develop a report on ‘frontier technologies to protect the environment and tackle climate change’.

**Green Standards Week**: The annual ITU Green Standard Week discusses the relationship between ICTs and circular economy and how frontier technologies could assist cities in becoming smarter and more sustainable. Themed ‘Connecting Smart Sustainable Cities with the Sustainable Development Goals’, the [9th ITU Green Standards Week](https://www.itu.int/en/ITU-T/Workshops-and-Seminars/gsw/201910/Pages/default.aspx) will be held in Valencia, Spain, 1-4 October 2019, organized by ITU together with 37 partners.

**Smart Sustainable Cities**: The [United for Smart Sustainable Cities (U4SSC)](http://www.itu.int/en/ITU-T/ssc/united/Pages/default.aspx) initiative, supported by 16 UN bodies, advocates for public policy to ensure that ICTs – and ICT standards in particular – play a definitive role in the transition to smart cities. A range of city ‘fact sheets’ developed under the auspices of U4SSC will be launched at the 9th ITU Green Standards Week. The fact sheets address the relationship between smart city initiatives and the Sustainable Development Goals, sharing insight into cities’ experiences in this regard.

**Project implementing the U4SSC Key Performance Indicators for Smart Sustainable Cities:** More than 100 cities worldwide are measuring their progress using 'Key Performance Indicators for Smart Sustainable Cities' based on ITU standards. ITU case studies have evaluated the progress achieved in the smart city projects of Dubai, Singapore and Moscow, evaluations undertaken using the Key Performance Indicators.

**ITU and ETSI** continue to enjoy successful collaboration in areas including multimedia QoE and IP capacity and latency parameters; ICT energy efficiency and methodologies to assess ICTs’ environmental impacts; standardization for C&I testing; and Test and Test Control Notation version 3.

**ITU and OASIS** continue collaboration on ICT security standardization. ITU adopted OASIS STIX as ITU-T X.1215 “Use Cases for Structured Threat Information Expression (STIX)”.

**ITU and FIDO Alliance** (‘Fast Identity Online’) continue collaboration on identity management. ITU adopted FIDO UAF 1.1 as ITU-T X.1277 **“**FIDO Universal Authentication Framework (UAF)” and adopted FIDO CTAP as ITU-T X.1278 “Client To Authenticator Protocol/Universal 2-factor framework”. See relevant [ITU News story](https://news.itu.int/new-itu-standards-to-overcome-the-security-limitations-of-passwords/).

**ITU and the NGMN Alliance** cooperate in support ofthe development of next-generation mobile broadband technologies. The two organizations are also working together to promote a level playing field for intellectual property licensing. See relevant [ITU News story](https://news.itu.int/itu-ngmn-promoting-level-playing-field-5g-intellectual-property/).

**Financial Inclusion Global Initiative** **(FIGI)** 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. The initiative is designed to advance research in digital finance and accelerate digital financial inclusion in developing countries. The second FIGI symposium was held in Cairo, Egypt, 22-24 January 2019. See relevant [category of ITU News stories](https://news.itu.int/category/et/digital-finance/).

**ITU and Stanford University** have agreed to launch a new partnership to support pilot implementations of DFC, digital currency authorized and issued by a Central Bank. The partnership will offer technical assistance to Central Banks piloting the introduction of DFC and an open forum to share lessons learnt from these pilots among Central Banks, digital currency platform providers, payment system organizations, academia, and telecoms companies. See relevant [ITU News story](https://news.itu.int/itu-stanford-university-launch-new-partnership-supporting-pilots-digital-fiat-currency/).

## 6.5 Cooperation with national and regional standardization organizations

TSB supports the achievement of Objective T.5 of the Strategic Plan of the Union, "Extend and facilitate cooperation with international, regional and national standardization bodies", by facilitating 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.

Activities with notable participation from other standards bodies include:

* [ITU-WHO Workshop on "Artificial Intelligence for Health"](https://aiforgood.itu.int/programme/day-2/), Geneva, Switzerland, 29 May 2019.
* [AI for Good Global Summit](https://aiforgood.itu.int/), Geneva, Switzerland, 28-31 May 2019.
* [ITU-WHO Workshop on "Artificial Intelligence for Health"](https://www.itu.int/en/ITU-T/Workshops-and-Seminars/20190402/Pages/default.aspx), Shanghai, China, 1 April 2019.
* [ITU-UNECE Symposium on the Future Networked Car](https://www.itu.int/en/fnc/2019/Pages/default.aspx), 7 March 2019, Geneva, Switzerland
* [ITU-NGMN Conference on "Licensing practices in 5G industry segments"](https://www.itu.int/en/ITU-T/Workshops-and-Seminars/itu-ngmn/Pages/20190129.aspx), Geneva, Switzerland, 29-30 January 2019.
* [ITU-TTC Workshop on the Future of Vehicular Multimedia](https://www.itu.int/en/ITU-T/Workshops-and-Seminars/20190123/Pages/default.aspx), Tokyo, Japan, 23 January 2019.
* [ITU-WHO Workshop on "Artificial Intelligence for Health"](https://www.itu.int/en/ITU-T/Workshops-and-Seminars/ai4h/20190122/Pages/default.aspx), Lausanne, Switzerland, 22 January 2019.
* [World Smart City Forum](https://www.worldsmartcity.org/), organized by IEC, ISO and ITU in Santa Fe, Argentina, 29 November 2018.
* [ITU-SAE Workshop on "How communications will change vehicles and transport"](https://www.itu.int/en/ITU-T/Workshops-and-Seminars/20181008/Pages/default.aspx), Detroit, U.S., 8-9 October 2018.

TSB continues to increase its engagement with the activities of other standards bodies, including:

**CEN**-**CENELEC:** TSB participated in the CEN-CENELEC Annual Meeting in Bucharest, Romania, 5-7 June 2018.

**Pan American Standards Commission (COPANT):** TSB participated in COPANT's Annual General Assembly in Cartegena, Colombia, 5-8 May 2019.

**Pacific Area Standards Congress (PASC)**: TSB participated in the PASC Annual General Meeting in Wellington, New Zealand, 8-12 April 2019.

**African Organization for Standardization (ARSO):** TSB participated in the ARSO General Assembly in Nairobi, Kenya, 17-19 June 2019, where ITU and ARSO signed a Cooperation Agreement (see section 6.4). ITU’s Secretary-General and the senior management of BR and TSB welcomed the ARSO Secretary-General for an official visit to ITU on 4 July 2019.

# 7 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 are: 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 Study Groups 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 1 - Five pillars of the BSG Programme

## 7.1 BSG hands-on training sessions

ITU-T has introduced the new 'BSG Hands-On Study Group effectiveness training' in response to WTSA Resolution 44. The training focuses 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 Study Groups, drafting contributions to meetings, presenting proposals, collaborative working methods and building consensus.

## 7.2 Regional Groups

Regional Groups within ITU-T Study Groups have proven effective mechanisms to coordinate regional contributions to ITU and increase the number and quality of technical contributions from developing countries. More than 500 participants attended the 18 Regional Group meetings held since October 2018:

* Six in Africa (Study Groups 2, 3, 5, 12, 13, 17 and 20)
1. SG2-RGAFR: Tunis, Tunisia, 26-27 April 2018: 23 participants.
2. **SG2-RGAFR: Cairo, Egypt, 4-6 December 2018:** 38 participants.
3. **SG3-RGAFR:** Antananarivo, Madagascar, 18-22 February 2019: 53 participants.
4. SG12**-RGAFR**: Kigali, Rwanda, 7-8 March 2019: 40 participants.
5. SG13**-RGAFR**: Abuja, Nigeria, 5-6 February 2019: 39 participants.
6. SG17**-RGAFR**: Tunis, Tunisia, 2-3 April 2019: 22 participants.
* Three for the Americas (Study Groups 2, 3 and 5)
	1. SG2-RGAMR: Managua, Nicaragua, 28-29 March 2019: 17 participants.
	2. SG3-RGLAC: Managua, Nicaragua, 25-29 February 2019: 24 participants.
	3. SG5-LATAM: **Bogota, Colombia, 24 October 2018: 24 participants.**
* Five for the Arab States (Study Groups 2, 3, 5 and 17)
1. SG2-RGARB: Cairo, Egypt, 4-6 December 2018: 26 participants.
2. SG3-RGARB: Kuwait City, Kuwait, 19-20 December 2018: 36 participants.
3. SG5-RGARB: **Kuwait city, Kuwait, 18 December 2018: 26 participants.**
4. SG17-RGARB: Tunis, Tunisia, 2-3 April 2019: 22 participants.
5. SG17-RGARB: **Kuwait City, Kuwait, 25 October 2018: 18 participants.**
* Four for Eastern Europe, Central Asia and Transcaucasia (Study Groups 3, 11, 13 and 20).
1. SG3-RGEECAT: Saint Petersburg, Russian Federation, 21 May 2019: 23 participants.
2. SG11-RGEECAT: Saint Petersburg, Russian Federation, 21-22 May 2019: 23 participants.
3. SG13-RGEECAT: Saint Petersburg, Russian Federation, 23 May 2019: 25 participants.
4. SG20-RGEECAT: Minsk, Belarus, 26-28 February 2019: 30 participants.

## 7.3 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 Regional Groups to improve the alignment of RSF discussions and the priorities of ITU-T Study Groups, being held in coordination with Regional Groups. RSFs are also raising awareness of our standards activities through the participation of key decision makers (Prime Ministers, Ministers, Heads of Regulators, CEOs, etc.).

The [ITU Regional Standardization Forum on Emerging Economic, Regulatory and Policy Trends in a Fast-Changing Digital World](https://www.itu.int/en/ITU-T/Workshops-and-Seminars/bsg/20181217/Pages/default.aspx) was held in Kuwait City, Kuwait, 17 December 2018.

## 7.4 National Standardization Secretariats

ITU-T has finalized [new Guidelines for National Standardization Secretariats (NSS)](https://www.itu.int/en/ITU-T/gap/Documents/nss-rep-may.pdf), taking into account the Membership feedback on the Guidelines first published in 2014. The new 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 in this document, 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 telecommunication standardization policies; the number and type of organizations with an interest in telecommunication 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 Study Groups (e.g. whether as an initiator of work items, active contributor or observer in one or more ITU-T Study Groups).

## 7.5 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>.

The most recent addition to the ITU Academia platform trains developers of systems compliant with ITU-T F.921 “Audio-based indoor and outdoor network navigation system for persons with vision impairment”. The course was developed by Wayfindr, in collaboration with TSB and BDT.

## 7.6 Study Group Mentoring Programme

In 2011, a mentoring programme for ITU-T Study Groups 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 Study Groups and TSAG.

## 7.7 Technical Papers

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

## 7.8 Fellowships

The table below shows the fellowships awarded during the period from October 2018 until July 2019. 252 fellowships were requested and 205 fellowships were awarded. Of the 205 fellowships awarded, 155 fellowships were used and 50 were cancelled.

| Meeting | Fellows | Total |
| --- | --- | --- |
| Female | Male |
| ITU-T SG15,Geneva, 8-19 October 2018 | 0 | 7 (2 cancelled) | 9 fellowships awarded,7 participants |
| ITU-T SG17RG-ARB, Kuwait City, Kuwait, 25 October 2018 | 0 | 2 | 2 fellowships awarded, 2 participants |
| ITU-T SG9, Bogota, Colombia, 21-28 November 2018 | 0 | 1 (2 cancelled) | 3 fellowships awarded, 1 participant |
| ITU-T SG12,Geneva, 27 November to 6 December 2018 | 1 | 8 | 9 fellowships awarded, 9 participants |
| ITU-T SG20*,* Wuxi, China, 3 - 13 December 2018 | 1 | 4 (3 cancelled) | 8 fellowships awarded, 5 participants |
| ITU-T SG2RG-ARB and SG2RG-AFR, Cairo, Egypt 4-6 December 2018 | 3 (2 cancelled) | 7 (3 cancelled) | 15 fellowships awarded, 10 participants |
| TSAG, Geneva, 10-14 December 2018 | 1 | 7 (1 cancelled) | 8 fellowships awarded,7 participants |
| ITU-T SG3RG-ARB and SG5RG-ARB, Kuwait City, Kuwait 18-20 December 2018 | 0 | 2 (1 cancelled) | 3 fellowships awarded,2 participants |
| ITU-T SG17, Geneva, 22-30 January 2019 | 1 | 6 (2 cancelled) | 9 fellowships awarded,7 participants |
| ITU-T SG3RG-AFR, Antananarivo, Madagascar, 18-22 February 2019 | 4 (2 cancelled) | 10 (3 cancelled) | 19 fellowships awarded,14 participants |
| ITU-T SG2, Geneva, 19-28 February 2019 | 0 | 8 (2 cancelled) | 10 fellowships awarded,8 participants |
| ITU-T SG20RG-EECAT, Minsk, Belarus, 26-28 February 2019 | 1 | 0 (1 cancelled) | 2 fellowships awarded,1 participant |
| ITU-T SG12RG-AFR, Kigali, Rwanda, 7-8 March 2019 | 3 | 11 (1 cancelled) | 15 fellowships awarded,14 participants |
| ITU-T SG13, Victoria Falls, Zimbabwe, 4-14 March 2019 | 0 (1 cancelled) | 3 | 4 fellowships awarded,3 participants |
| ITU-T SG11, Geneva, 6-15 March 2019 | 0 | 4 (3 cancelled) | 7 fellowships awarded,4 participants |
| ITU-T SG16, Geneva, 6-15 March 2019 | 2 (1 cancelled) | 3 | 6 fellowships awarded,5 participants |
| ITU-T SG2RG-AMR and SG3RG-LAC, Managua, Nicaragua, 28-29 March 2019 | 1 | 2 | 3 fellowships awarded,3 participants |
| ITU-T SG17RG-AFR and SG17RG-ARB, Tunis, Tunisia, 2-3 April 2019 | 1 (1 cancelled) | 4 (4 cancelled) | 10 fellowships awarded,5 participants |
| ITU-T SG20, Geneva, 9-18 April 2019 | 2 | 3 (3 cancelled) | 8 fellowships awarded,5 participants |
| ITU-T SG3, Geneva, 23 April - 2 May 2019 | 7 (2 cancelled) | 9 (2 cancelled) | 20 fellowships awarded,16 participants |
| ITU-T SG12, Geneva, 7-16 May 2019 | 0 | 6 (2 cancelled) | 8 fellowships awarded,6 participants |
| ITU-T SG5, Geneva, 13-22 May 2019 | 3 (2 cancelled) | 3 (1 cancelled) | 9 fellowships awarded,6 participants |
| ITU-T SG3RG-EECAT, SG11RG-EECAT and SG13RG-ECCAT, Saint-Petersburg, Russia, 21-23 May 2019 | 2 | 1 | 3 fellowships awarded,3 participants |
| ITU-T SG9, Geneva, 6-13 June 2019 | 1 | 5 (3 cancelled) | 9 fellowships awarded,6 participants |
| ITU-T SG15, 1-12 July 2019 | 0 | 6 | 6 fellowships awarded,6 participants |

## 7.9 Questionnaires for developing countries

Two questionnaires on"Big Data Adoption in Developing Countries" and the "Use of ITU-T Recommendations by Developing Countries"were distributed in July 2018. The deadline for replies was extended until 31 August 2019.

Responses to the first questionnaire will inform the development of a new Supplement on "Big Data Adoption in Developing Countries". The questionnaire is collecting data on the main opportunities, requirements, use cases and challenges relevant to Big Data adoption in developing countries. Its objective is to identify issues that could be addressed by ITU-T Recommendations or related guidelines.

Responses to the second questionnaire will support the promotion of ITU-T Recommendations in developing countries, contributing to the BSG programme. The questionnaire is collecting information on how developing countries use ITU-T Recommendations and standards developed by other standards bodies.

## 7.10 World Telecommunication and Information Society Day

ITU celebrated the 50th anniversary of [World Telecommunication and Information Society Day (WTISD)](https://news.itu.int/itu-celebrates-world-telecommunication-and-information-society-day/) at ITU headquarters in Geneva on 17 May 2019. The theme for WTISD 2019 was "Bridging the standardization gap". WTISD celebrations featured a panel discussion on the importance of inclusive international standards for digital health, digital financial inclusion, and smart cities and communities. Six award winners, in the following categories, were honoured for their significant contributions to ITU’s work to bridge the standardization gap. See relevant [ITU News story](https://news.itu.int/itu-celebrates-world-telecommunication-and-information-society-day/).

**Awareness:** The Asia-Pacific Telecommunity Wireless Group was recognized for its outstanding efforts to raise awareness of the importance of international standardization.

**Know-how:** Lwando Bbuku, Zambia Information & Communications Technology Authority, Co-chairman of ITU-T SGRG-AFR, was recognized for his significant accomplishments in increasing his expertise in international standards development.

**Community:** Tunisia and the U.S. were recognized for their recent hosting of considerable numbers of the ITU meetings that bring together the international standardization community.

**Engagement:** China was recognized for increasing its participation in ITU standardization work.

**Partnering:** Korea was recognized for its consistent financial and in-kind support for ITU's Bridging the Standardization Gap programme.

# 8 Membership

## 8.1 Evolution of ITU-T membership

ITU-T membership has maintained strong growth in 2019, achieving a net increase of 22 memberships since December 2018 (not including Academia). During this period, 14 Sector Members and 26 Associates joined ITU-T, amounting to a total of 40 new members. In addition, 16 new Academia members joined, leading to a net increase of four Academia memberships.

New ITU-T members include companies in energy and utilities, shipping and logistics, mobile payments, over-the-top applications, automotive, IoT/M2M connectivity, distributed ledger technologies, quantum communications, cybersecurity, AI, and quality of service and experience.

Targeted membership outreach, campaigns and events – executed in collaboration by TSB's Strategic Engagement Division and Study Groups Department – continue to show great promise in attracting and recruiting new ITU-T members. TSB continues to put an increased emphasis on tailored outreach to membership prospects while also enhancing the level of account management to ITU-T's existing membership.

New Sector Members in 2019:

Bangladesh Communication Satellite Company Limited (BCSCL); Beijing Baidu Netcom Science Technology Co., Ltd.; CAS Quantum Network Co. Ltd.; QuantumCTek Co., Ltd.; Credit Pilot PLC; Volkswagen AG; Subah Infosolutions Ghana Limited; Reliance Jio Infocomm Limited; LG Uplus; Infinera Corporation; ITRI International Inc.; Plantronics, Inc.; XPRIZE Foundation Inc.; and ADA Innovation Lab, Ltd..

New Associates in 2019:

Maersk Line A/S (SG2); Vattenfall Vindkraft A/S (SG2); Clementvale Baltic OÜ (SG2); Bouygues Telecom (SG2); Athalos PRS-Telecom (SG2); Tele2 IoT (SG2); Phonegroup SA (SG2); Dense Air (SG2); Arkessa, Ltd. (SG2); MovieLabs (SG9); Synamedia (SG9); OpenSignal, Ltd. (SG12); Continental Automotive Systems Inc. (SG12); Hyundai Mobis Co., Ltd (SG12); CEZ Distribuce, a.s. (SG15); Signify/Philips Lighting B.V. (SG15); u-blox AG (SG15); IBM (SG15); Tibit Communications (SG15); Xilinx Inc. (SG15); VisionVera Information Technology Co., Ltd. (SG16); Fondation Botnar (SG16); Cambridge Quantum Computing (SG17); Capital City Service Limited (SG17); FORTINET Inc. (SG17); and System Engineering Research Institute (SG20).

New Academia in 2019:

Universidad Nacional del Litoral; Hong Kong Applied Science and Technology Research Institute; Institut Scientifique Européen; Ilmenau University of Technology; Centre for Development of Telematics; Amirkabir University of Technology; Tarbiat Modares University; University of Tehran; Tokyo Institute of Technology; Arab States Research and Education Network; Smart Quantum Communication ITRC, Korea University; Hamad Bin Khalifa University; University of Dodoma; University of Bristol; Universidad Técnica del Norte; and Shinshu University.

Total ITU-T Sector Members, Associates and Academia (31 December 2006 – 31 July 2019):

The following table and figure illustrate the evolution of the ITU-T membership from 31 December 2006 to 31 July 2019 (noting that the Academia membership category opened in 2011).

**Table 1: Evolution of ITU-T membership from 31 December 2006 to 31 August 2019**

|  | **2006** | **2007** | **2008** | **2009** | **2010** | **2011** | **2012** | **2013** | **2014** | **2015** | **2016** | **2017** | **2018** | **2019** |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Sector Members | 344 | 314 | 309 | 294 | 273 | 271 | 278 | 284 | 274 | 267 | 254 | 258 |  261 | 267 |
| Associates | 112 | 116 | 134 | 128 | 125 | 136 | 144 | 139 | 134 | 134 | 130 | 139 |  162 | 178 |
| Academia | ‑ | - | ‑ | ‑ | ‑ | 25 | 36 | 45 | 86 | 109 | 107 | 125 | 155 | 159 |
| TOTAL  | 456 | 430 | 443 | 422 | 398 | 432 | 458 | 468 | 494 | 510 | 491 | 522 | 578 | 604 |

**Figure 3 – Evolution of ITU-T membership from 31 December 2006 to 31 August 2019**

NOTE – The Academia category was created in 2011.

## 8.2 Implementation of SME Pilot Project

ITU-T Study Groups 5, 11, 16 and 20 have implemented a pilot project to increase the engagement of SMEs in the work of ITU. The participation of 16 SMEs in ITU-T has been approved by their relevant administrations as part of the pilot project.

Examples of work underway as a result of this pilot project include:

* In ITU-T SG5, WaveControl (Spain) is leading the development of the work item K.workers on "Assessment and management of compliance with RF EMF exposure limits for workers at radiocommunication sites and facilities"; and MJRD Assessment Inc. (Canada) is leading the development of the work item L.SP\_OB on "A methodology for improving, assessing and scoring the sustainability performance of office buildings".
* In ITU-T SG11, Vaulto Technologies (Israel) contributed a Technical Report on the abuse of SS7 security vulnerabilities to commit financial fraud. Vaulto Technologies' work in ITU-T SG11 has led to the establishment of a new work item to assist network operators an financial institutions in addressing SS7 security vulnerabilities.
* In ITU-T SG16, Wayfindr (UK) contributed the material that became ITU-T F.921 and FSTP-CONF-F921 on indoor and outdoor network navigation for persons with visual impairments.

A number of SMEs currently participating in this pilot project have expressed a strong interest in applying for Associate status under the reduced fee structure contained in Resolution 209 (Dubai, 2018), which will come into effect on 31 January 2020.

# 9 Gender

In alignment with ITU-T Resolution 55 (Rev. Hammamet, 2016), TSB continues to undertake actions to improve gender equality in TSB and ITU-T. 60 per cent of all TSB promotions over the last two years were awarded to women in the Professional category of staff. TSB has endorsed the "Gender Responsive Standards" initiative by UNECE which aims to improve gender balance in standards development and ensure that the content and impacts of standards are gender responsive. Diversity of staff, gender equality and the empowerment of women continue to be among TSB's priorities.

# 10 Academia

## 10.1 ITU Kaleidoscope academic conferences

The ITU Kaleidoscope series of peer-reviewed academic conferences – technically co-sponsored by the IEEE Communications Society – calls for original research on ICT innovation and related demands on international standardization.

The 10th edition of Kaleidoscope, [Kaleidoscope 2018: Machine Learning for a 5G future](https://www.itu.int/en/ITU-T/academia/kaleidoscope/2018/Pages/default.aspx), was held in Santa Fe, Argentina, 26-28 November 2018, hosted by Universidad Tecnológica Nacional. The winning paper, authored by researchers at Japan’s National Institute of Information and Communications Technology, highlighted Machine Learning’s potential to support automated network slicing. See relevant [ITU News story](https://news.itu.int/1st-prize-at-kaleidoscope-2018/). Authors of outstanding Kaleidoscope 2018 papers were invited to contribute to the work of the [ITU-T Focus Group on Machine Learning for Future Networks including 5G](https://www.itu.int/en/ITU-T/focusgroups/ml5g/Pages/default.aspx).

The 11th edition of Kaleidoscope, [Kaleidoscope 2019: ICT for Health: Networks, standards and innovation](https://www.itu.int/en/ITU-T/academia/kaleidoscope/2019/Pages/default.aspx), organized by ITU in collaboration with WHO, will be held in Atlanta, U.S., 4-6 December 2019, hosted by ITU Academia member, the Georgia Institute of Technology. IEEE, IEEE ComSoc and The Lancet Digital Health are technical co-sponsors of Kaleidoscope 2019. [The Lancet Digital Health](https://www.thelancet.com/journals/landig/home) may publish selected papers presented at Kaleidoscope. See relevant [ITU News story](https://news.itu.int/how-can-digital-health-serve-everyone-submit-your-paper-to-kaleidoscope-2019/).

## 10.2 ITU Journal: ICT Discoveries

In December 2018, a special issue of the ITU Journal dedicated to the theme "[Data for Good](https://www.itu.int/en/journal/002/Pages/default.aspx)" published original academic papers investigating the technical, business and policy challenges underlying effective data management and analysis. See relevant [ITU News story](https://news.itu.int/journal-issue-2/).

In February 2019, ITU issued a Call for Papers for a new special issue on "[Propagatiom modelling for advanced future radio systems – Challenges for a congested radio spectrum](https://www.itu.int/en/journal/2019/001/Pages/default.aspx)". This issue is due to be published in December 2019. See relevant [ITU News story](https://news.itu.int/navigating-crowded-spectrum-itu-journal-invites-research-on-advances-in-radiowave-propagation/).

In July 2019, ITU issued a Call for Papers for a new special issue on "[The future of video and immersive media](https://www.itu.int/en/journal/2020/001/Pages/default.aspx)". The issue is inviting submissions until 11 November 2019. See relevant [ITU News story](https://news.itu.int/itu-journal-future-video-immersive-media/).

The new PP Resolution 207 (Dubai, 2018) highlights ITU membership’s support for the ITU Journal. The ITU Journal has also embarked on a new expansion effort, an effort that began with ITU signing a co-publishing agreement with Tsinghua University Press in January 2019.

## 10.3 World Standards Cooperation and Academia

IEC, ISO and ITU organize academic events under the banner of the World Standards Cooperation to discuss the role played by academia in the standards-development process.

WSC Academic Days took place in China (2011), Indonesia (2012), France (2013), Canada (2014), Korea (2015), Germany (2016), the U.S. (2017) and Indonesia (2018). These events are held in conjunction with the annual International Cooperation for Education about Standardization (ICES) conferences.

WSC Academic Day 2019 will take place in Belgrade, Serbia, 11 October 2019, hosted by the University of Belgrade. The central theme of WSC Academic Day 2019 will be the economic, social and environmental benefits of International Standards.

# 11 Publications

Over 14,000 pages of ITU-T Recommendations and Supplements were published between October 2018 and July 2019. Figure 4 illustrates the number of Recommendations (including Supplements) published per year since 2016, noting that 2019 covers only until August.

All major revisions of ITU-T Recommendations are now also being converted to the reflowable ePub format, and will soon be 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.

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. The USB key incorporates advanced search tools, including detailed search-by-content capabilities. Search parameters can be defined by keywords, timeframe and Study Group, among others, with searches applicable to the title or the full text of the standard.

 

Figure 2 – Number of Recommendations, amendments and Supplements
published per year since 2016

# 12 Media and promotion

TSB maintains a consistent output of original ITU-T news content, coupled with a coordinated social media strategy led by the ITU General Secretariat.

TSB produces the most communications of any sector and these communications feature among the most popular ITU content each year. ITU-T news is published on the new [ITU News platform](http://news.itu.int/), a mobile-optimized platform which supports the incorporation of multimedia and improves search-engine results and sharing. A new ['Standards' category of ITU News](https://news.itu.int/category/standards/) focuses on the work of ITU-R and ITU-T.

TSB communications are systematically distributed using a variety of social media channels including Twitter, Facebook, LinkedIn, Weibo and YouTube. Infographics, animations and video form part of coordinated packages of TSB communications.

High-priority ITU-T news topics include:

* Transport and access, video coding, and performance, QoS and QoE are of great interest to ITU-T's audience. The success of related ITU-T news can be attributed to ITU's leadership and credibility in these fields.
* 5G, trust, IoT and smart cities are effective 'headline' topics, helping ITU-T news to highlight how ITU standards support ICT users.
* 'Emerging trends' such as AI, ITS, blockchain, DFS and quantum information technologies are also proving popular with ITU-T's audience.

# 13 Services and tools

Electronic working methods offer crucial support to members engaged in ITU-T standardization work. TSB continues to develop new applications and services to maintain and expand ITU-T's advanced electronic working environment.

## 13.1 ITU-T databases

To serve ITU-T delegates and secretariat staff, the following databases are available online:

* [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](http://www.itu.int/net/itu-t/ls/)
* [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 13.6 for more details)
* [ITS Communication Standards database](https://www.itu.int/net4/ITU-T/landscape#?topic=0.131&workgroup=1&searchValue=&page=1&sort=Revelance) (from CITS)
* [ICT standards landscape](https://www.itu.int/en/ITU-T/studygroups/com17/ict/Pages/default.aspx) (from SG17)

## 13.2 ITU-T MyWorkspace

MyWorkspace is a set of mobile-friendly tools and services to facilitate the work of ITU-T experts. MyWorkspace responds to WTSA Resolution 32 on strengthening electronic working methods. The first version was released in 2017 and has since welcomed 1,600 users. The site receives visits from an average of 500 users per month.

The latest version, version 3.0, was released in the second quarter of 2019. Version 3.0 includes enhances the user interface and includes a new section for ITU-T events. MyWorkspace is accessible through a responsive website and new mobile application (Android & iOS). Secure access to MyWorkspace is enabled through ITU User Account (TIES) credentials.

The following services are available from the platform:

* ITU-T experts directory
* Chat service for real-time communication
* Meeting documents with the option to bookmark favourites
* Mailing list subscriptions
* Calendar of ITU-T events with filters by working group
* User profile management (CRM profiles) and additional preferences
* New applications included in 2019:
* Neural-net based machine translation prototype for documents in the six official languages (including formatting)
* Remote participation service frequently used by study groups, based on an open-source tool
* New ITU-T events service, fully integrated with CRM events and registered participants, including a ‘matchmaking’ feature to enhance delegate networking.

## 13.3 ITU search engine

The mobile-friendly [ITU search engine](https://www.itu.int/net4/ITU-T/search/Landing) facilitates access to ITU documents, websites, publications and other resources. 2018 saw the expansion of the tool from ITU-T resources to the resources of all ITU Sectors. An average of 15,000 searches take place each month.

The latest version of the search engine was released in December 2018. This latest version includes:

* Filters to narrow searches by Sector, type of document or language
* New collections available:
	+ Meeting documents and websites from all ITU Sectors
	+ Social media (ITU Facebook and Twitter accounts) and Multimedia (ITU Flickr and YouTube accounts)
* New section to search resolutions and decisions of ITU governing bodies
* Multilingual search, support any of the six official languages

## 13.4 ITU-T services & tools announcements

A service announcements platform, <http://tsbtech.itu.int/>, keeps the ITU-T community up to date with the latest enhancements to the services and tools provided to ITU-T members.

## 13.5 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 Study Groups, notably Study Groups 2, 3, 9, 11, 13, 15, 16 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).

## 13.6 International Numbering Resources (INRs)

A prototype of a new repository of national numbering plans has been developed and is available at: <https://www.itu.int/net4/itu-t/nnp>. The prototype responds to WTSA Resolution 91 (Hammamet, 2016) on "Enhancing access to an electronic repository of information on numbering plans published by the ITU Telecommunication Standardization Sector". Pursuant to the relevant ITU-T Recommendations, Member States are invited to provide information on the presentation of their national numbering plans and amendments thereto in a timely manner, so as to ensure that the electronic repository remains up to date.

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".

ITU-T E.156 "Guidelines for ITU-T action on reported misuse of E.164 number resources" is under revision to include new cases of misuse and to investigate more efficient means of combating misuse.

Following the instruction of WTSA Resolution 20 (Rev. Hammamet, 2016), the TSB Director informed ITU Council 2019 of recently received reports of numbering resource misuse. TSB has been working in close collaboration with the experts of ITU-T SG2 in investigating the reported misuse of one particular ITU telephone number.

Member States are encouraged to contribute to the implementation of PP Resolution 190 (Busan, 2014) "Countering misappropriation and misuse of international telecommunication numbering resources", in particular "to continue to study ways and means to improve the understanding, identification and resolution of misappropriation and misuse of ITU-T E.164 telephone numbers through activities of ITU-T and ITU-D study groups" and "develop national legal and regulatory frameworks that are sufficient to ensure best practices in ITU-T E.164 telephone numbering management in order to counter telephone number misappropriation and misuse".

Council 2017 approved the new fee structure for UIFN (Universal International Freephone Number) and IIN (Issuer Identifier Number) by approving new Decision 600 ([C17/133](https://www.itu.int/md/S17-CL-C-0133/en)) and 601 ([C17/134](https://www.itu.int/md/S17-CL-C-0134/en)). ITU has been in the process of implementing these Decisions.

* The improved systems went live on 16 January 2018 following the new fee structure approved in Council Decision 600.
* At its February 2019 meeting, ITU-T SG2 approved revisions to ITU-T E.169.1 "Application of Recommendation E.164 numbering plan for universal international freephone numbers for international freephone service" and ITU-T E.118 "The international telecommunication charge card" to reflect Council Decision 600 and 601.
* For the UIFN annual maintenance fee for 2018, invoices representing CHF 744,200 were distributed in January 2018. Applying the principle of pro rata fee for newly joined Sector Members in 2018, the total amount to be paid was CHF 553,567. As of 10 June 2019, CHF 224,600 (41 per cent) has been received. It is important to note, however, that 45 per cent of the unpaid CHF 328,967 concerns only two UIFN service providers.
* The lists of invoices for the IIN annual maintenance fees of 2018 and 2019 have not yet been generated as TSB continues to seek confirmation of relevant contact information from national Administrations/regulators or authorized agencies for IIN assignees.

Although progress is being achieved in implementing Council Decisions 600 and 601, further assistance from Member States is required either to identify the contact information of UIFN service providers and IIN assignees or ensure that invoices are paid on time. It was also observed that Council Decision 600 encouraged operators to update their list of active UIFNs and return the unused UIFNs to ITU, and that Council Decision 601 improves the precision of the IIN records kept in the ITU database.The following recommendation was approved by ITU Council 2019:

*The list of UIFN service providers in Annex A to Document C19/47 will be marked as "not reachable" in the ITU database. The records for these UIFN service providers are subject to removal from the ITU database and the UIFNs assigned to them are subject for reclamation based on confirmations/notifications from national Administrations/regulators as recommended by Council 2018. Among these UIFN service providers, for the ones to whom invoices for the maintenance fee for 2018 have been sent, the invoices will be cancelled.*

*If the invoices sent to the UIFN service providers in Annex B to Document C19/47 remain unpaid for an extended period, the secretariat will seek assistance from Member States to recover the debt.*

*National Administrations/regulators or authorized agencies are encouraged to provide assistance in identifying the up-to-date contact or status of the UIFN service providers (e.g., if they are no longer in business) listed in Annex C to Document C19/47.*

*The list of IINs for which contact information is pending will be published on ITU website as IINs with the status "assignee not reachable" and will be announced in the ITU Operational Bulletin. National Administrations/regulators or authorized agencies are encouraged to provide assistance in identifying their up-to-date status and/or contact information.*

*For the UIFNs and IINs which are still under consultation with national Administrations/regulators or authorized agencies, their status should be confirmed before 31 October 2019. If no objection is received from national Administrations/regulators or authorized agencies, the corresponding UIFNs and IINs will be considered as no longer active and removed from ITU databases.*

*UIFN service providers or IIN assignees with the status of ADMIN RELATED are not subject to the annual maintenance fee.*

## 13.7 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 found below:

* ITU-T Study Groups (Study Period 2017-2020) (<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 DPM - ITU-T Focus Group on Data Processing and Management to support IoT and Smart Cities & Communities (<https://extranet.itu.int/sites/itu-t/focusgroups/dpm/>)
* FG DFC - ITU-T Focus Group on Digital Currency including digital fiat currency (<https://extranet.itu.int/sites/itu-t/focusgroups/dfc/>)
* FG DLT - ITU-T Focus Group on Application of Distributed Ledger Technology (<https://extranet.itu.int/sites/itu-t/focusgroups/fgdlt/>)
* FG ML5G - ITU-T Focus Group on Machine Learning for Future Networks including 5G (<https://extranet.itu.int/sites/itu-t/focusgroups/ML5G/>)
* FG NET-2030 – ITU-T Focus Group on Technologies for Network 2030 (<https://extranet.itu.int/sites/itu-t/focusgroups/net-2030/>)
* FG-AI4H - ITU-T Focus Group on Artificial Intelligence for Health (<https://extranet.itu.int/sites/itu-t/focusgroups/ai4h/>)
* FG-VM - ITU-T Focus Group on Vehicular Multimedia
(<https://extranet.itu.int/sites/itu-t/focusgroups/vm/>)
* FG-AI4EE - Focus Group on Environmental Efficiency for Artificial Intelligence and other Emerging Technologies
(<https://extranet.itu.int/sites/itu-t/focusgroups/ai4ee/>)

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.

## 13.8 Meeting Documents Sync Application

This application enables meeting participants to synchronize documents of ongoing ITU-T Study Group meetings from the ITU server to their local drive. The application is constantly enhanced and updated following feedback and suggestions from users. An improved Windows version and a new Mac version of the sync application for RGM documents are now available.

## 13.9 Electronic meetings

TSB continues to improve electronic meeting facilities offered to ITU-T members. 2019 saw the introduction of a new tool for ITU-T electronic meetings with the aim of providing a consistent, efficient service to the ITU-T community. This tool is now being used for all ITU-T statutory meetings. Adobe Connect will continue to be used for multilingual sessions. GoToMeeting and Zoom are used for non-statutory, fully online (virtual) and any on-demand ad-hoc meetings. Statistics on e-meetings for the last three years are indicated below.



Figure 3 – Remote participation and e-meetings

## 13.10 Use in the ITU-T of the 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 Study Groups in terminology-related matters. SCV guides the adoption of terms and definitions in ITU-T Recommendations in accordance with WTSA Resolution 67.

[Council Resolution 1386](https://www.itu.int/md/S17-CL-C-0127/en) of 26 May 2017 created the ITU Coordination Committee for Terminology (CCT), which is composed of SCV, the ITU-R Coordination Committee for Vocabulary (CCV) and two representatives of ITU-D. SCV met twice in the reporting period, under the umbrella of CCT, ensuring the harmonization of terminology across the Union.

TSB continues to collect all new terms and definitions proposed by ITU-T Study Groups, 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, in the reporting period, 24 AAP Recommendations, in accordance with requests received from ITU-T Study Groups and linguistic groups.

## 13.11 Workshops and symposia

ITU workshops and symposia discuss emerging trends in standardization, increase the visibility of ITU-T work, enhance ITU-T collaboration with other bodies, attract and recruit new ITU-T members, and encourage peer-learning relevant to the development and implementation of international standards.

The following ITU workshops and symposia, arranged by venue, were organized by TSB since November 2018:

**ITU Headquarters, Geneva:**

* [ITU Workshop on ''Cybersecurity Challenges in Automated Driving"](https://www.itu.int/en/ITU-T/studygroups/2017-2020/17/Pages/mini-workshop_ITS.aspx), 26 August 2019.
* [ITU Workshop on ''Fintech Security"](https://www.itu.int/en/ITU-T/Workshops-and-Seminars/20190826/Pages/default.aspx), 26 August 2019.
* [ITU Workshop on ''Distributed Ledger Scalability and Interoperability"](https://www.itu.int/en/ITU-T/Workshops-and-Seminars/201908/Pages/default.aspx), 2 August 2019.
* [ITU Workshop on ''Data Processing and Management for IoT and Smart Cities & Communities"](https://www.itu.int/en/ITU-T/Workshops-and-Seminars/20190719/Pages/default.aspx), 19 July 2019.
* [ITU Workshop on "Enhancing human life using e-services"](https://www.itu.int/en/ITU-D/Regional-Presence/Europe/Pages/Events/2019/eServices/enhancing-human-life-using-e-services.aspx), 25 March 2019
* [ITU Workshop on "Machine Learning for 5G and beyond"](https://www.itu.int/en/ITU-T/Workshops-and-Seminars/20190617/Pages/default.aspx), 17 June 2019.
* [ITU Digital Fiat Currency Showcase: Use cases and architecture options](https://www.itu.int/en/ITU-T/Workshops-and-Seminars/201906/Pages/default.aspx), 13 June 2019.
* [ITU Workshop on "Future of TV for Europe"](https://www.itu.int/en/ITU-T/Workshops-and-Seminars/20190607/Pages/default.aspx), 7 June 2019.
* [ITU/WHO Workshop on "Artificial Intelligence for Health",](https://aiforgood.itu.int/programme/day-2/) 29 May 2019 (within the AI for Good Global Summit).
* [AI for Good Global Summit](https://aiforgood.itu.int/), 28-31 May 2019.
* [ITU Symposium on "ICT, Environment and Climate Change](https://www.itu.int/en/ITU-T/climatechange/symposia/201905/Pages/default.aspx)", 13 May 2019.
* [Smart Environment Panel on "GHG emissions trajectories for the ICT sector",](https://www.itu.int/en/ITU-T/studygroups/2017-2020/05/Pages/event-20190515.aspx) 15 May 2019
* [Smart Environment Panel on "New ITU standards on soft errors that affect telecommunications](https://www.itu.int/en/ITU-T/studygroups/2017-2020/05/Pages/event-20190520.aspx)", 20 May 2019
* [WSIS Forum: "Internet of Things - From idea to reality, making it happen in Africa](https://www.itu.int/net4/wsis/forum/2019/Agenda/ViewSession/254)", 11 April 2019.
* [WSIS Thematic Workshop on "Connecting the Circular model of E-waste Management to the Sustainable Development Goals](https://www.itu.int/net4/wsis/forum/2019/Agenda/ViewSession/240)", 11 April 2019
* [WSIS Thematic Workshop on "United for Smart Sustainable Cities: Blockchain for Cities](https://www.itu.int/net4/wsis/forum/2019/Agenda/ViewSession/296)", 11 April 2019
* [WSIS Thematic Workshop on "(En)gendering the Smart City](https://www.itu.int/net4/wsis/forum/2019/Agenda/ViewSession/277)", 11 April 2019
* [ITU Workshop on "Enhancing Human Life Using e-Services"](https://itu.int/en/ITU-D/Regional-Presence/Europe/Pages/Events/2019/eServices/enhancing-human-life-using-e-services.aspx), 25 March 2019.
* [ITU Workshop on "Benchmarking of Emerging Technologies and Applications. Internet Related Performance Measurements"](https://www.itu.int/en/ITU-T/Workshops-and-Seminars/20190311/Pages/default.aspx), 11 March 2019.
* [ITU-UNECE Symposium on the Future Networked Car](https://www.itu.int/en/fnc/2019/Pages/default.aspx), 7 March 2019.
* [Joint ITU-NGMN Conference on "Licensing practices in 5G industry segments](https://www.itu.int/en/ITU-T/Workshops-and-Seminars/itu-ngmn/Pages/20190129.aspx), 29-30 January 2019.
* [ITU Workshop on "Artificial Intelligence, Machine Learning and Security](https://www.itu.int/en/ITU-T/Workshops-and-Seminars/20190121/Pages/default.aspx)", 21 January 2019.
* [ITU Workshop on "Telecommunication Service Quality Regulatory Frameworks and Experience-Driven Networking](https://www.itu.int/en/ITU-T/Workshops-and-Seminars/qos/201811/Pages/default.aspx)", 26 November 2018.

**Rest of Europe (see above for Geneva):**

* [ITU Workshop on "Distributed Ledger Technology](https://www.itu.int/en/ITU-T/focusgroups/dlt/Documents/20190401-workshop-agenda.pdf)", Madrid, Spain, 1 April 2019.
* [ITU Workshop on "Network 2030](https://www.itu.int/en/ITU-T/Workshops-and-Seminars/20190218/Pages/default.aspx)", London, United Kingdom, 18 February 2019.
* [ITU/WHO Workshop on "Artificial Intelligence for Health"](https://www.itu.int/en/ITU-T/Workshops-and-Seminars/ai4h/20190122/Pages/default.aspx), Lausanne, Switzerland, 22 January 2019.
* [ITU Forum "Towards 5G Enabled Gigabit Society"](https://www.itu.int/en/ITU-D/Regional-Presence/Europe/Pages/Events/2018/5GForum/Towards_5G_Enabled_Gigabit_Society.aspx), Athens, Greece, 11-12 October 2018.

**Africa:**

* [ITU Digital African Week](https://www.itu.int/en/ITU-T/climatechange/Pages/1st-Digital-African-Week.aspx), Abuja, Nigeria, 27-30 August 2019.
* [ITU Workshop on "Network Performance, Quality of Service and Quality of Experience"](https://www.itu.int/en/ITU-T/Workshops-and-Seminars/qos/201903/Pages/default.aspx), Kigali, Rwanda, 4-5 March 2019.
* [ITU Regional Standardization Forum on "Emerging Economic, Regulatory and Policy Trends for an Inclusive, Sustainable and Trustworthy Digital World](https://www.itu.int/en/ITU-T/Workshops-and-Seminars/bsg/20190218/Pages/default.aspx)", Antananarivo, Madagascar, 18 February 2019.

**Asia and the Pacific:**

* [ITU Workshop on ''Telecommunication Service Quality as Enabler of the Digital Economy"](https://www.itu.int/en/ITU-T/Workshops-and-Seminars/qos/201908/Pages/default.aspx), Singapore, 19-21 August 2019.
* [TSB Director's CJK CTO Consultation Meeting](https://www.itu.int/en/ITU-T/tsbdir/cto/Pages/default.aspx), 16 July 2019, Tokyo, Japan.
* [ITU Workshop on "Quantum Information Technology (QIT) for Networks"](https://www.itu.int/en/ITU-T/Workshops-and-Seminars/2019060507/Pages/default.aspx), Shanghai, China, 5-7 June 2019.
* [ITU Workshop on "Future Integrated Broadband Cable Networks](https://www.itu.int/en/ITU-T/studygroups/2017-2020/09/Wuhan-WSP/Pages/default.aspx)", Wuhan, China, 14 April 2019.
* [ITU/WHO Workshop on "Artificial Intelligence for Health"](https://www.itu.int/en/ITU-T/Workshops-and-Seminars/20190402/Pages/default.aspx), Shanghai, China, 1 April 2019.
* [ITU Workshop on "Towards a New Era - AI in 5G"](https://www.itu.int/en/ITU-T/Workshops-and-Seminars/201903/Pages/default.aspx), Shenzhen, China, 6 March 2019.
* [ITU Workshop on "The Future of Vehicular Multimedia"](https://www.itu.int/en/ITU-T/Workshops-and-Seminars/20190123/Pages/default.aspx), Tokyo, Japan, 23 January 2019.
* [ITU Workshop on "Data Processing and Management for IoT and Smart Cities & Communities](https://www.itu.int/en/ITU-T/Workshops-and-Seminars/201901/Pages/default.aspx)", Seoul, Korea, 14 January 2019.
* [ITU Workshop on "Technologies for Network 2030](https://www.itu.int/en/ITU-T/Workshops-and-Seminars/20181218/Pages/default.aspx)", Hong Kong, China, 18 December 2018.
* [ITU Forum on "Artificial Intelligence, Internet of Things and Smart Cities](https://www.itu.int/en/ITU-T/Workshops-and-Seminars/201812/Pages/default.aspx)", Wuxi, China, 3 December 2018.

**Arab States**:

* [Arab-African Interregional ITU Standardization Forum on "PKI for e-trust](https://www.itu.int/en/ITU-T/Workshops-and-Seminars/bsg/2019040405/Pages/default.aspx)", Tunis,Tunisia, 4-5 April 2019.
* [Financial Inclusion Global Initiative (FIGI) Symposium](https://www.itu.int/en/ITU-T/extcoop/figisymposium/2019/Pages/default.aspx), Cairo, Egypt, 22-24 January 2019.
* [ITU Regional Standardization Forum on "Emerging Economic, Regulatory and Policy Trends in a Fast-Changing Digital World](https://www.itu.int/en/ITU-T/Workshops-and-Seminars/bsg/20181217/Pages/default.aspx)", Kuwait City, Kuwait, 17 December 2018.
* [ITU Interregional Workshop on "ITU International Numbering Resources for the Arab and Africa Regions](https://www.itu.int/en/ITU-T/Workshops-and-Seminars/2018120204/Pages/default.aspx)", Cairo, Egypt, 2-4 December 2018.

**Americas:**

* [HLPF Side Event: "Harnessing Frontier Technologies for Accelerating Climate Actions and the SDGs"](https://www.itu.int/en/ITU-T/climatechange/Pages/20190709.aspx), New York, United States, 9 July 2019.
* STI Forum Side Event: Frontier Technologies to Protect the Environment and Tackle Climate Change, New York, United States, 14 May 2019.
* [7th Workshop on "SMART Cable Systems: From the Laboratory to the Ocean Floor"](https://www.itu.int/en/ITU-T/Workshops-and-Seminars/20190412/Pages/default.aspx), New Orleans, United States, 12 April 2019.
* [BSG Interactive ITU Workshop on "Effectiveness in Standardization](https://www.itu.int/en/ITU-T/Workshops-and-Seminars/bsg/20190327/Pages/default.aspx)", Managua, Nicaragua, 25-26 March 2019.
* [ITU Workshop on "ITU International Numbering Resources for the Americas](https://www.itu.int/en/ITU-T/Workshops-and-Seminars/2019032526/Pages/default.aspx)", Managua, Nicaragua, 25-26 March 2019.
* [FG DLT Pre-meeting Workshop on "Distributed Ledger Technology for Transparency and Integrity](https://www.itu.int/en/ITU-T/focusgroups/dlt/Pages/default.aspx)", Rio de Janeiro, Brazil, 14 January 2019.
* [World Smart City Forum](https://www.worldsmartcity.org/), Santa Fe, Argentina, 29 November 2018.
* [ITU Kaleidoscope: Machine Learning for a 5G Future](https://www.itu.int/en/ITU-T/academia/kaleidoscope/2018/Pages/default.aspx), Santa Fe, Argentina, 26-28 November 2018.
* [ITU Workshop on "The Future of TV for the Americas"](https://www.itu.int/en/ITU-T/Workshops-and-Seminars/201811/Pages/default.aspx), Bogotá, Colombia, 26 November 2018.
* [ITU Workshop on "Artificial Intelligence for Health"](https://www.itu.int/en/ITU-T/Workshops-and-Seminars/20181114/Pages/default.aspx), New York City, United States, 14 November 2018.
* [ITU/SAE Workshop on "How communications will change vehicles and transport"](https://www.itu.int/en/ITU-T/Workshops-and-Seminars/20181008/Pages/default.aspx), Detroit, MI, United States, 8-9 October 2018.
* [ITU Workshop on "Network 2030](https://www.itu.int/en/ITU-T/Workshops-and-Seminars/201810/Pages/default.aspx)", New York, United States, 2 October 2018.

**CIS:**

* [ITU Workshop on "Network 2030" in conjunction with the ITU Forum on "Internet of Things: Future Applications and Services. Perspective 2030](https://www.itu.int/en/ITU-T/Workshops-and-Seminars/201905/Pages/default.aspx)", Saint-Petersburg, Russian Federation, 21-23 May 2019.
* [ITU-UN-Habitat-UNDP Forum on "Smart sustainable cities: technological trends, success stories and future prospects"](https://www.itu.int/en/ITU-D/Regional-Presence/CIS/Pages/EVENTS/2019/02_Minsk/02_Minsk.aspx), Minsk, Belarus, 26-27 February 2019.
* [ITU Training on "Key Performance Indicators for Smart Sustainable Cities to achieve the SDGs"](https://www.itu.int/en/ITU-D/Regional-Presence/CIS/Pages/EVENTS/2019/02_Minsk/02_Minsk.aspx), Minsk, Belarus, 27 February 2019.

# 14 Implementation of WTSA Resolutions and A-series ITU-T Recommendations

WTSA Resolution 22 instructs the TSB Director to report to TSAG on the implementation of WTSA resolutions and actions to be undertaken pursuant to their operative paragraphs. WTSA Resolution 22 also instructs the TSB Director to report to TSAG on the implementation of the A-series ITU-T Recommendations.

WTSA Resolutions are available at <http://www.itu.int/pub/T-RES>.

The WTSA-16 Action Plan ([TSAG-TD292](https://www.itu.int/md/T17-TSAG-181210-TD-GEN-0292)) assigns action items to the operational provisions in the Resolutions and also reports information on the progress of the implementation of those action items.

A-series ITU-T Recommendations are available at <https://itu.int/rec/T-REC-A>.

# 15 ITU-T's activities in the implementation of WSIS and the Sustainable Development Goals

ITU-T's work contributes to the implementation of the mandates conferred on ITU by the World Summit on the Information Society (WSIS), in particular to Action Lines C2 (Information and communication infrastructure), C5 (Building confidence and security in the use of ICTs) and C7 (e-Environment).

ITU-T has undertaken a mapping of its activities to the UN Sustainable Development Goals (SDGs), an action highlighting the ITU-T activities most relevant to the SDGs and proposing actions for ITU-T to expand its contribution to the pursuit of the SDGs.

This mapping of ITU-T work to the SDGs will support the WSIS process in its promotion of efforts to leverage ICTs for sustainable development (see the [WSIS-SDG Matrix](https://www.itu.int/net4/wsis/sdg/) linking WSIS Action Lines with the SDGs), highlighting areas where these efforts will receive support from the international standards developed by ITU-T.

This mapping was presented to the February 2016 meeting of TSAG ([TSAG-TD419](http://www.itu.int/md/T13-TSAG-160201-TD-GEN-0419/en)) and led to the development of a mapping tool to map ITU-wide objectives and outputs to SDG goals and targets.

# 16 Implementation of trial authorized by TSAG (July 2016 meeting)

In implementing the decision of the July 2016 meeting of TSAG (C.108/TSAG), an ad-hoc group created by ITU-T SG13 in February 2017 has delivered guidance for drafting ITU-T Recommendations. The final meeting of this ad-hoc group took place during the March 2019 meeting of ITU-T SG13 meeting in Victoria Falls, Zimbabwe.

The resulting guideline document – ["Guidelines and methodologies for developing technical Recommendations"](https://www.itu.int/md/meetingdoc.asp?lang=en&parent=T17-SG13-190304-TD-PLEN-0172) – has been submitted to TSAG for further consideration, as described in the Liaison Statement [SG13-TD170-R1/PLEN](https://www.itu.int/md/meetingdoc.asp?lang=en&parent=T17-SG13-190304-TD-PLEN-0170).

# 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.993.2 (revised) "Very high speed digital subscriber line transceivers 2 (VDSL2)"** specifies an access technology that exploits the existing infrastructure of copper wires that were originally deployed for POTS services. It can be deployed from central offices, from fibre-fed cabinets located near customer premises, or within buildings. This Recommendation is an enhancement to ITU T G.993.1 that supports asymmetric and symmetric transmission at a bidirectional net data rate up to 200 Mbit/s on twisted pairs using a bandwidth up to 30 MHz.

This version of this Recommendation integrates all the previous amendments and corrigenda with the 2011 version of Recommendation ITU-T G.993.2. This version of Recommendation ITU-T G.993.2 corrects or adds the following functionality:

* Method to address the misestimation of the SNR during MEDLEY (Amendment 2)
* Segmentation of SOC messages for profile 35b (Corrigendum 1)
* Annex D: Long reach VDSL2 (Amendment 3)
* Near-end anomalies for loss-of-power, host-reinit and spontaneous interruptions (Amendment 4)
* Addition of operation per the North American region for profile 35b (Annex Q) (Amendment 4)
* Addition of operation per the China region for profile 35b (Annex Q) (new)
* Addition of Successful SRA counter (new)
* Long reach VDSL2 corrigendum related to MAXNOMATP (new)
* Corrigendum to MAXMASK definition in Table 7 5 (new)
* Corrigendum to use of US0 with 35b profile for the North-America region (new).

**ITU-T G.993.5 (revised) "Self-FEXT cancellation (vectoring) for use with VDSL2 transceivers"** is specifically limited to the self-far-end crosstalk (self-FEXT) cancellation in the downstream and upstream directions. It defines a single method of self-FEXT cancellation, in which FEXT generated by a group of near-end transceivers and interfering with the far-end transceivers of that same group is cancelled. This cancellation takes place between very high-bit-rate digital subscriber line 2 (VDSL2) transceivers, not necessarily of the same profile. This Recommendation is intended to be implemented in conjunction with Recommendation ITU T G.993.2. This version of this Recommendation integrates all of the previous amendments and corrigenda with the 2015 version 2.0 of Recommendation ITU-T G.993.5. This version of Recommendation ITU-T G.993.5 corrects or adds the following functionality:

* Typographical correction in clause 8.2 (Corrigendum 1)
* Generalization of the segmentation of SOC messages in clause 10.4.2.2 for vectoring of profile 35b (Corrigendum 1)
* Transceiver O-DEACTIVATING state (Amendment 1)
* Annex A: Mitigating strong FEXT (Amendment 2)
* Annex B: Vectored Long Reach VDSL2 (Amendment 2)
* Encoding of R-P-VECTOR-2 in LR mode with long loop operation (Annex B) (Corrigendum 2)
* Long reach VDSL2 corrigendum related to MAXNOMATP (new).

**ITU-T G.997.1 (revised) "Physical layer management for digital subscriber line transceivers"** specifies the physical layer management for asymmetric digital subscriber line (ADSL) and very high speed digital subscriber line 2 (VDSL2) transmission systems. It specifies means of communication on a transport transmission channel defined in the physical layer Recommendations ITU-T G.992.1, ITU-T G.992.2, ITU-T G.992.3, ITU-T G.992.4, ITU T G.992.5 and ITU-T G.993.2. It specifies network elements (NE) content and syntax for configuration, fault and performance management.

The revision of this Recommendation includes the management information base (MIB) elements for the physical layer management of Recommendation ITU T G.993.2 and additional MIB elements for the physical layer management of Recommendations ITU T G.992.3 and ITU-T G.992.5. The 2018 edition of this Recommendation integrates ITU-T G.997.1 (2016) and all its amendments and corrigenda. It adds the following new technical material:

* Add support for G.993.2 Annex N PSD masks.
* Add support of MAXEFTR and extend the definition of the parameters "error-free bits counter" and "MINEFTR" to apply to line with retransmission inactive.

**ITU-T G.997.2 (revised) "Physical layer management for G.fast transceivers"** specifies the physical layer management for fast access to subscriber terminals (G.fast) transmission systems. It specifies managed objects for configuration, fault, status, inventory and performance management. The 2018 edition of this Recommendation integrates ITU-T G.997.2 (2015) and all its amendments and corrigenda. It adds the following new technical material:

* Correction on loss of power definition for RPF.
* Correction to the special value of SNRps
* Inclusion of managed objects for showtime reconfiguration
* Correction to the range of valid values of LOM\_PERSISTENCYds/us
* Inclusion of managed objects CLASSMASKds/us.

**ITU-T G.999.1 (revised) "Interface between the link layer and the physical layer for digital subscriber line (DSL) transceivers"** defines a point-to-point interface between the LINK layer device such as a network processor and a PHY device supporting multiple DSL lines, such as VDSL2, ADSL2, and SHDSL.

Corrigendum 1 to Recommendation ITU-T G.999.1 (2009) contains:

* Resolution of an inconsistency with TCI bit mapping relative to IEEE 802.1q
* Clarification of LENGTH field bit mapping
* Editorial corrections and clarifications to various clauses throughout the Recommendation.

Amendment 1 to Recommendation ITU-T G.999.1 (2009) provides the following update:

* Revision to clause 6.3 with extension for flow control on the PHY-to-LINK data stream over gamma reference point.
* Update of clause 7, Table 7-1 Configuration parameters for the encapsulation.

This revision adds support for 2.5 Gbit/s and 10 Gbit/s LINK/PHY physical interfaces.

**ITU-T G.9700 (revised) "Fast access to subscriber terminals (G.fast) – Power spectral density specification"** specifies power spectral density (PSD) mask requirements for fast access to subscriber terminals (G.fast), a set of tools to support reduction of the transmit PSD mask, profile control parameters that determine spectral content, including the allowable maximum aggregate transmit power into a specified termination impedance, and a methodology for transmit PSD verification. It complements the physical layer (PHY) specification in Recommendation ITU-T G.9701.

Amendment 1 provided support for a new 106 MHz profile with +8 dBm maximum aggregate transmit power.

Amendment 2 aligns the text of clause 6.5 on notching of specific frequency bands with ITU-T G.9701 (2014) and its latest amendments, completes the specification of 212 MHz profiles, adds Annex X ''Adaptation to the coax medium'' in support of Annex X ''Operation without multi-line coordination intended for a crosstalk free environment'' that has been specified in amendment 3 to ITU-T G.9701, and updates the table of International amateur radio frequencies in Appendix I.

The 2019 version of ITU-T G.9700 integrates the previous version and its amendments, and adds a new 106 MHz limit PSD mask intended to be used for transmission over networks with increased shielding, such as those with shielded cables or where cables are buried underground.

**ITU-T G.9701 (revised) "Fast access to subscriber terminals (G.fast) – Physical layer specification"** specifies a gigabit broadband access technology that exploits the existing infrastructure of wire-pairs that were originally deployed for plain old telephone service (POTS) services. Equipment implementing this Recommendation can be deployed from fibre-fed distribution points (fibre to the distribution point, FTTdp) located very near the customer premises, or within buildings (fibre to the building, FTTB). This Recommendation supports asymmetric and symmetric transmission at an aggregate net data rate up to 1 Gbit/s on twisted wire-pairs using spectrum up to 106 MHz and specifies all necessary functionality to support far-end crosstalk (FEXT) cancellation between multiple wire-pairs, and facilitates low power operation.

Corrigendum 1 (2015) provides clarifications and corrects various errors in the Recommendation, and in particular includes a change to the definition of DFT output samples.

Corrigendum 2 (2016) increases the number of RFI bands from 16 to 32, and provides clarifying text on alignment between TIGA and SRA/FRA procedures, tone repetition, unavailable seconds, and byte order in SOC and eoc messages.

Amendment 1 (2016) specifies test parameters, some of which had previously been left for further study, and specifies support for low power operation.

Amendment 2 (2016) includes a new annex on cross-layer traffic monitoring functions and link state control to support low power operation. It also includes a new 106 MHz profile with increased maximum transmit power, support for increased bit loading, Hlog reporting in both directions, and Xlog reporting.

Corrigendum 3 (2017) adds several clarifications, and fixes various errors and inconsistencies.

Amendment 3 adds support for new functionality: full specification of the 212 MHz profile, Annex X – Operation without multi-line coordination intended for a crosstalk free environment (e.g., coaxial cable medium) including independent dynamic time assignment (iDTA), Annex T – higher layer control aspects of DTA, and Annex S – software download to NTs.

Amendment 4 supports new functionality for impulse noise monitoring (INM), robust management channel recovery (RMCR), and performance monitoring parameter ANDEFTR.

Corrigendum 5 adds several clarifications, and fixes various errors and inconsistencies.

Amendment 5 adds support for coordinated dynamic time assignment (cDTA).

Corrigendum 6 includes:

* Correction of Figure 10-25 in §10.4.4 "Cyclic extension and windowing" according to Q4-180423-C29 (Issue 10.71).
* Revision of the text on §11.2.2.5 "OLR commands and responses" according to Q4-180423-C31R1 (Issue 10.73). Further revised according to WD1018 (Issue 10.79).
* Revision of the text of §13.2.1.1 "SRA procedures" according to Q4-180423-C20R1 (Issue 10.70). Further revised according to Q4-180423-C32R1 (Issue 10.73). Further revised according to WD1018 (Issue 10.79).
* Revision of the text of §13.3.1.1.1.1 "FRA time window (fra-time)" according to Q4-180423-C30R1 (Issue 10.72).
* Replacing BRMC with NRMC in §9.5 according to Q4-180625-C34 (Issue 10.75).
* Revision of the text of §11.3.1.1 "Near end anomalies" according to Q4-180827-C02R1 (Issue 10.74).
* Revision of the text of §11.4.4.7.3.3 "INM inter arrival time histogram primitives" according to Q4-180827-C17R1 (Issue 10.78.1).
* Revision of the text of §11.4.1.2.2 "Signal-to-noise ratio per subcarrier (SNR-ps)" according to Q4-180827-WD02R1 (Issue 10.76.1).
* Revision of the text of §12.3.4.2.1 "O-MSG 1", §12.3.4.2.2 "R-MSG 2", and §11.2.2.11 "Management counter read commands responses" according to WD1015 (Issue 10.77.1.1).

Amendment 6 includes:

* Addition of new §5.6 "Reconfiguration of the line" according to Q4-180423-WD04R1 (Issue 20.32.76). Further revised according to Q4-180625-C02R1 (Issue 20.32.82). Further revised according to Q4-180827-WD03R2 (Issue 20.32.88).
* Revision of the text of §10.2.2.1 "Sync symbol encoder" according to Q4-180827-C26R1 (Issue 20.57.2). Further revised according to C1040R1 (Issue 20.57.3).
* Revision of the text of §10.3.2.5.2 "Time identification control parameters" according to Q4-180827-C26R1 (Issue 20.57.2). Further revised according to C1040R1 (Issue 20.57.3).
* Revision of the text of §11.1.1 "γ\_MGMT interface" according to Q4-180423-WD04R1 (Issue 20.32.76).
* Revision of the text of §11.3.1.1 "Near-end anomalies" according to Q4-180423-WD04R1 (Issue 20.32.76). Further revised according to Q4-180625-C02R1 (Issue 20.32.82). Moved to Annex R.5 according to Q4-180827-WD03R2 (Issue 20.32.88).
* Revision of the text of §12.3.2 "G.994.1 handshake phase" according to Q4-180827-C26R1 (Issue 20.57.2). Further revised according to C1040R1 (Issue 20.57.3). Further revised according to WD0964 (Issue 20.62.1).
* Revision of the text of §12.3.3.2.1 "O-SIGNATURE" according to C1040R1 (Issue 20.57.3).
* Revision of the text of §12.3.4.2.1 "O-MSG 1"and §12.3.4.2.2 "R-MSG 2" (Issue 20.32.90).
* Addition of text for new Annex R "Showtime reconfiguration" according to WD0421 (Issue 20.32.62). Revised according to Q4-180423-WD04R1 (Issue 20.32.76). Further revised according to Q4-180625-C02R1 (Issue 20.32.82). Further revised according to Q4-180827-WD03R2 (Issue 20.32.88). Further revised according to WD0885 (Issue 20.32.89).
* Addition of text for new Annex V "Targeted generalized vectoring (TGV)" according to Q4-180423-C28R1 (Issue 20.49.9.1). Revised according to Q4-180827-C25R1 (Issue 20.49.13). Revised according to WD1042 (Issue 20.49.14).
* Changed DTA to iDTA throughout as appropriate (AMD.5 LC comment resolution).

**ITU-T G.9701 (2019) Amd.1 "Fast access to subscriber terminals (G.fast) – Physical layer specification – Amendment 1"** (under approval) includes enhancements to DTA functionality.

**ITU-T G.9710 "Multi-gigabit fast access to subscriber terminals (MGfast) – Power spectral density specification"** (under approval) specifies power spectral density (PSD) mask requirements for Multi-gigabit fast access to subscriber terminals (MGfast), a set of tools to support reduction of the transmit PSD mask, and a methodology for transmit PSD verification. It supports operation over both twisted pair and coaxial cable media.

I.1.2 Ultra-high-speed access including NG-PON2

**ITU-T G.984.2 (revised) "Gigabit-capable Passive Optical Networks (G-PON): Physical Media Dependent (PMD) layer specification"** describes a flexible optical fibre access network capable of supporting the bandwidth requirements of business and residential services, and covers systems with nominal line rates of 1244.160 Mbit/s and 2488.320 Mbit/s in the downstream direction and 155.520 Mbit/s, 622.080 Mbit/s, 1244.160 Mbit/s and 2488.320 Mbit/s in the upstream direction. Both symmetrical and asymmetrical (upstream/downstream) Gigabit-capable Passive Optical Network (GPON) systems are described. This Recommendation proposes the physical layer requirements and specifications for the Physical Media Dependent (PMD) layer. The Transmission Convergence (TC) layer and ranging protocol for GPON systems are described in a different ITU-T Recommendation.

This Recommendation describes a system that represents an evolutionary development from the system described in ITU-T Rec. G.983.1. To the greatest extent possible, this Recommendation maintains the requirements of ITU-T Rec. G.983.1 to insure maximal continuity with existing systems and optical fibre infrastructure. In addition, it describes several enhanced optical budgets (B+, C+, and D) to extend that capability. The necessary parameters are defined to support optical layer supervision.

**ITU-T G.988 (2017) Amd.2 "ONU management and control interface (OMCI) specification - Amendment 2"** contains updates to ITU-T G.988 (2018 Amd 1). This amendment adds support for DC voltage based visual message indicators in G.988 VOIP application service profile ME. This amendment makes editorial changes on Extended VLAN.

**ITU-T G.989.2 (revised) "40-Gigabit-capable passive optical networks 2 (NG PON2): Physical media dependent (PMD) layer specification"** specifies the physical media dependent (PMD) layer requirements for a passive optical network (PON) system with a nominal aggregate capacity of 40 Gbit/s in the downstream direction and 10 Gbit/s in the upstream direction, hereinafter referred to as NG-PON2. NG-PON2 is a flexible optical fibre access network capable of supporting the bandwidth requirements of mobile backhaul, business and residential services. Furthermore, this Recommendation describes optional configurations, to extend beyond this nominal capacity, as the ITU-T G.989 series of Recommendations allows for multiple upstream and downstream line rates.

This Recommendation specifies the characteristics of hybrid time and wavelength division multiplexing (TWDM) channels, referred to as TWDM PON. The characteristics of optional, tunable point-to-point wavelength overlay channels are also described, referred to as point-to-point wavelength division multiplexing (PtP WDM) PON.

The TWDM PON described in this Recommendation represents a further development from the systems described in the ITU-T G.984 and ITU-T G.987 series of Recommendations. To the greatest extent possible, this Recommendation retains the requirements of ITU-T G.984.1 and ITU-T G.987.1 to ensure maximal reuse of existing technology and compatibility with deployed optical access systems and optical fibre infrastructure.

Edition 2.0 continues the maintenance and evolution of physical media dependent (PMD) layer specification.

**ITU-T G.989.3 Amd2 "40-Gigabit-capable passive optical networks (NG PON2): Transmission Convergence (TC) layer specification"** continues the evolution of NG-PON2 Transmission Convergence (TC) layer, introducing TWDM channel bonding, making additions and changes to the PLOAM channel, providing DBA enhancements, and performing regular specification maintenance.

**ITU-T G-series Supplement "5G Wireless Fronthaul Requirements in a PON Context"** enumerates the various requirements arising from 5G wireless systems, concentrating on the fronthaul portion of the network, and considers how they compare with current and future optical access transport systems. Practical passive optical network solutions to serve the 5G fronthaul application are hypothesized.

I.1.3 Optical fibres

**ITU-T G.9803 "Radio over fiber systems"** defines fundamental architecture and requirements for radio over fiber system and specifies radio over fiber transmission systems suitable for access network and radiolocation applications.

**ITU-T G.9803 Amd.1 "Radio over fibre systems – Amendment 1"** develops a new type of optical access network based on radio-over-fibre (RoF) technologies. This Recommendation describes a fundamental architecture and requirements for RoF systems. This Recommendation specifies the system overview, physical layer requirements, system requirements and co-existence with passive optical network (PON) for analogue RoF systems supporting the international mobile telecommunication (IMT) system over optical distribution network (ODN). This Recommendation also describes the system overview and physical layer requirements for analogue RoF systems supporting the foreign object debris (FOD) detection system.

**ITU-T G.9804.1 "Higher Speed Passive Optical Networks: Requirements**" (under approval) serves as a guide to the development of higher speed PON systems, by identifying sets of applications that can be addressed by a particular system, and defining the requirements for each of those systems. It is anticipated that there may have several distinct systems, such as higher speed single channel (TDMA-PON), higher speed multi-channel (TWDM-PON), and higher speed point to point overlay PONs.

**ITU-T L.163 "Criteria for optical fibre cable installation with minimal existing infrastructure"** describes criteria for the installation of optical fibre cables defined in [ITU-T L.110] in remote areas with lack of usual infrastructure for installation including the procedures of cable-route planning, cable selection, cable-installation scheme selection, cable tension and temperature consideration, and the handling, bend protection and river/lake closing of the cable together with pilot tests and training for installation.

This Recommendation also describes how to mitigate the considerable risks and/or issues to which the optical fibre cable may be exposed when infrastructures are minimal during installation, maintenance and operation procedures.

**ITU-T L.208 "Requirements for passive optical nodes: Fibre distribution boxes**" refers to Fibre Distribution Boxes (FDB) deployed as passive optical nodes in indoor or outdoor environments. It deals with the FDB housing, FDB fibre management system, cable attachment and termination system, and specifies the mechanical and environmental characteristics as well.

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

**ITU-T G.709/Y.1331 (2016) Amd.3 "Interfaces for the optical transport network (OTN): Amendment 3"** contains extensions to the fifth edition (06/2016) of ITU-T Recommendation G.709/Y.1331, related to the:

* Addition of interconnection of Ethernet UNI and FlexE Group UNI in two administrative domains (7.5, Appendix XIV).
* Addition of 50GBASE-R mapping into ODUflex (2, 17.13.3, Annex J).
* Update of FlexE terminology and calendar slot descriptions with FlexE 2.0 IA (2, 17.11, 17.12).
* Redefine the OP overhead bit in bit 1 of JC6 as a RES overhead (20.4, 20.4.3.1, 20.5).
* Replacement of references to IEEE Std. 802.3-2015, 802.3by and 802.3bs by a reference to IEEE Std 802.3-2018 (2, 17.13.1, 17.13.2, Annex J, Annex K).
* Addition of ODU4 and ODUflex(25G/50G/200G/400GBASE-R) rows to Table 7-9 (7.4).
* Addition of 25G, 50G, 200G and 400GBASE-R rows to Table IX.1 (Appendix IX).
* Addition of ODUflex(25G/50GGBASE-R, FC-1600/3200) rows to Table X.1 (Appendix X).

**ITU-T G.709.1/Y.1331.1 Amd.1 "Flexible OTN short-reach interfaces: Amendment 1"** contains editorial changes to the second edition (06/2018) of ITU-T Recommendation G.709.1/Y.1331.1, related to the:

* FEC specification enhancements to align to G.709 format
* Replacement of PHY terminology to FlexO instances
* Fixed typos in clause 11.6.1

Fixed typo in AM value of Table 9-2.

**ITU-T G.709/Y.1331 (2016) Amd.3 "Interfaces for the optical transport network (OTN): Amendment 3"** (under approval) contains extensions to the fifth edition (06/2016) of ITU-T Recommendation G.709/Y.1331, related to the:

* Addition of interconnection of Ethernet UNI and FlexE Group UNI in two administrative domains (7.5, Appendix XIV).
* Addition of 50GBASE-R mapping into ODUflex (2, 17.13.3, Annex J).
* Update of FlexE terminology and calendar slot descriptions with FlexE 2.0 IA (2, 17.11, 17.12).
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* Replacement of references to IEEE Std. 802.3-2015, 802.3by and 802.3bs by a reference to IEEE Std 802.3-2018 (2, 17.13.1, 17.13.2, Annex J, Annex K).
* Addition of ODU4 and ODUflex(25G/50G/200G/400GBASE-R) rows to Table 7-9 (7.4).
* Addition of 25G, 50G, 200G and 400GBASE-R rows to Table IX.1 (Appendix IX).
* Addition of ODUflex(25G/50GGBASE-R, FC-1600/3200) rows to Table X.1 (Appendix X).

I.1.5 Optical transmission systems

**ITU-T G.671 (revised) "Transmission characteristics of optical components and subsystems"** covers the transmission-related aspects of all types of optical components used in long-haul networks and access networks. A broad range of types of optical components is included in this Recommendation. This Recommendation also includes transmission characteristics of optical components under the full range of operating conditions, but does not specify the operating service conditions, installation aspects or other aspects of components not affecting the optical transmission path. This Recommendation also draws upon the relevant IEC definitions and test methods where applicable.

**ITU-T G.709/Y.1331 (2016) Amd.3 "Interfaces for the optical transport network (OTN): Amendment 3"** (under approval) contains extensions to the fifth edition (06/2016) of ITU-T Recommendation G.709/Y.1331, related to the:

- Addition of interconnection of Ethernet UNI and FlexE Group UNI in two administrative domains (7.5, Appendix XIV).

- Addition of 50GBASE-R mapping into ODUflex (2, 17.13.3, Annex J).

- Update of FlexE terminology and calendar slot descriptions with FlexE 2.0 IA (2, 17.11, 17.12).

- Redefine the OP overhead bit in bit 1 of JC6 as a RES overhead (20.4, 20.4.3.1, 20.5).

- Replacement of references to IEEE Std. 802.3-2015, 802.3by and 802.3bs by a reference to IEEE Std 802.3-2018 (2, 17.13.1, 17.13.2, Annex J, Annex K).

- Addition of ODU4 and ODUflex(25G/50G/200G/400GBASE-R) rows to Table 7-9 (7.4).

- Addition of 25G, 50G, 200G and 400GBASE-R rows to Table IX.1 (Appendix IX).

- Addition of ODUflex(25G/50GGBASE-R, FC-1600/3200) rows to Table X.1 (Appendix X).

**ITU-T G.709.1/Y.1331.1 (2018) Amd.1 "Flexible OTN short-reach interfaces: Amendment 1"** (under approval) contains editorial changes to the second edition (06/2018) of ITU-T Recommendation G.709.1/Y.1331.1, related to the:

- FEC specification enhancements to align to G.709 format

- Replacement of PHY terminology to FlexO instances

- Fixed typos in clause 11.6.1

- Fixed typo in AM value of Table 9-2.

**ITU-T G.709.3/Y.1331.3 Amd.1 "Flexible OTN long-reach interfaces: Amendment 1"** contains extensions to the first edition (06/2018) of ITU-T Recommendation G.709.3/Y.1331.3, related to the:

- Enhancement of the FEC Block Alignment specification (11.3.1)

- Addition of 200G and 400G FlexO with Concatenated FEC (7, 7.2, 11.3, 11.3.1, 11.3.2, 12, 13, 14, 15, Annex C, Annex D, Appendix I, Appendix II)

- Deletion of m and n and addition of Z conventions (5).

**ITU-T G.798 (2017) Amd.2 "Characteristics of optical transport network hierarchy equipment functional blocks - Amendment 2"** (under approval) specifies both the components and the methodology that should be used in order to specify the optical transport network (OTN) functionality of network elements; it does not specify individual optical transport network equipment.

Amendment 1 contains text modifications and additions for:

– moving the ODUkP to Ethernet MAC layer and Ethernet Reconciliation sublayer adaptation functions from ITU-T G.8021 to ITU-T G.798.

– supporting the adaptation of ODUkP to Ethernet Coding sublayer for 25 Gb/s, 200 Gb/s and 400 Gb/s Ethernet signals.

– alignment with ITU-T G.8023.

– replacing Appendix VIII to align with ITU-T G.872 and ITU-T G.873.1

Amendment 2 contains text modifications and additions for:

– OTSi to OTU4 adaptation function with SC-FEC.

– OTSi to FlexO-1-SC adaptation function.

– alignment with ITU-T G.709.1.

**ITU-T G.807 "Generic functional architecture of the optical media network" (under approval)** 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 digital information that is being carried by a signal in the media network.

**ITU-T G.808.2 (revised) "Generic protection switching – Ring protection"** defines the generic functional models, characteristics and processes associated with various ring protection schemes for connection oriented networks; e.g., optical transport networks (OTNs), synchronous digital hierarchy (SDH) networks, and MPLS transport profile (MPLS-TP) networks. It also defines the objectives and applications for these schemes. The protection scheme described in this Recommendation is shared ring protection. Generic functional models, characteristics and processes for linear protection and interconnected subnetwork protection schemes are defined in other Recommendations.

**ITU-T G.7041/Y.1303 (2016) Amd.1 "Generic framing procedure – Amendment 1"** contains edits to enhance the clarity of the client bit numbering for the GFP-F mappings, especially the SSM bit numbering in clause 7.11. It also includes editorial corrections to labelling in four additional figures.

**ITU-T G.872 (revised) "Architecture of optical transport networks (OTN)"** (under approval) 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, client characteristic information, client/server layer associations, networking topology, layer network functionality and optical media network structure, that provide multiplexing, routing and supervision of digital clients. 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.875 (revised) "Optical transport network: Protocol-neutral management information model for the network element view"** provides a protocol-neutral management information model for managing network elements in the optical transport network (OTN). The model contains the managed entities and their properties that are useful to describe the information exchanged across interfaces defined in the ITU-T M.3010 telecommunications management network (TMN) architecture. The protocol-neutral management information model shall be used as the base for defining protocol-specific management information models, for example, common management information service element (CMISE), common object request broker architecture (CORBA) and simple network management protocol (SNMP) information models. Mapping from the protocol-neutral entities into protocol-specific objects is a decision of the specific protocol modelling design and should be described in the protocol-specific information model Recommendations.

**ITU-T G.7710/Y.1701 (revised) "Common equipment management function requirements"** addresses the equipment management functions (EMFs) inside a transport network element that are common to multiple technologies. For example, common applications are described for date and time, fault management, configuration management, account management, performance management and security management. These applications result in the specification of common EMF functions and their requirements.

The 2012 revision of this Recommendation has incorporated the following below.

– Recommendation ITU-T G.7710/Y.1701 Corrigendum 1 (11/2009):

 this mainly contains an updated equipment management function process block diagram.

– Recommendation ITU-T G.7710/Y.1701 Amendment 1 (07/2010):

 updates the packet layer related specification of severely errored second (SES) to align it with the SES definition in Recommendation ITU-T Y.1563.

– Recommendation ITU-T G.7710/Y.1701 Corrigendum 2 (04/2011):

 this adds the missing 6 LBC terms to the process description, and gives additional specifications on gauge measurement.

The 2019 revision of this Recommendation has incorporated the following below.

– Recommendation ITU-T G.7710/Y.1701 Amendment 1 (9/2016):

**–** Create new clause 12 for control plane function management, including fault event reporting for controller-based restoration.

**ITU-T G.7712/Y.1703 (revised) "Architecture and specification of data communication network"** defines the architecture requirements for a data communication network (DCN) which may support distributed management communications related to the telecommunication management network (TMN), distributed control plane communications (e.g., signalling and routing) related to the automatically switched optical network (ASON), distributed control plane communications (e.g., signalling and routing) related to multiprotocol label switching – transport profile (MPLS-TP), control plane communications related to Software Defined Networking (SDN), and other distributed communications (e.g., orderwire or voice communications, software download). The DCN architecture considers networks that are IP only, OSI-only, and mixed (i.e., support both IP and OSI). The interworking between parts of the DCN supporting IP-only, parts supporting OSI only, and parts supporting both IP and OSI are also specified – other protocols (other than IP or OSI) are outside the current scope of this Recommendation.

Various applications (e.g., TMN, ASON, etc.) require a packet-based communications network to transport information between various components. For example, the TMN requires a communications network, which is referred to as the management communication network (MCN) to transport management messages between TMN components (e.g., network element function (NEF) component and operations system function (OSF) component). ASON and MPLS-TP require communication networks, which are referred to as the signalling communication networks (SCNs) to transport signalling and routing messages between functional control plane components (e.g., connection controller (CC) components and routing controller (RC) components). This Recommendation specifies data communication functions that can be used to support one or more application's communication network.

The data communication functions provided in the 11/2001 version of this Recommendation support connectionless network services. The 03/2003 revision of this Recommendation adds the support of connection-oriented network SCN services by including a specific MPLS-based mechanism.

This 2010 revision of this Recommendation provides the requirements for the MPLS transport profile (MPLS-TP) signalling communication channel (SCC) and management communication channel (MCC) data communication functions. The part of this Recommendation that addresses MPLS for transport networks complies with the transport profile of MPLS architecture as defined by IETF. In the event of a difference between this ITU-T Recommendation and any of the normatively referenced RFCs for MPLS-TP, the RFCs will take precedence.

This Recommendation forms part of a family of Recommendations covering transport networks.

**ITU-T G.8052/Y.1346 (revised) "Protocol-neutral management information model for the Ethernet transport capable network element"** contains the protocol neutral UML information model for Ethernet transport network (NE) management. The model is based on the Ethernet equipment functions specified in Recommendation ITU-T G.8021/Y.1341, generic management requirements in Recommendation ITU-T G.7710/Y.1701, and Ethernet specific management requirements in Recommendation ITU-T G.8051/Y.1345.

The 2016 revision of this Recommendation changes the UML modelling tool from RSA to open source Papyrus tool, updates the Recommendation ITU-T G.8052/Y.1346 information model to align it with the Recommendation ITU-T G.7711/Y.1702 v2.0 Core information model, drops subclassing of the TP classes from Recommendation ITU-T M.3160, and supports the additional management requirements in Recommendation ITU-T G.8051/Y.1345.

The 2018 revision of this Recommendation up-versions the UML model tool to Papyrus v3.2.0 and the profile to v0.2.13, deletes ODUkP-X-L (from the CsfRdiFdiEnableSink\_Pac, CsfRdiFdiEnableSource\_Pac, and CsfReportSink\_Pac), replace ETY termination points with ETHnull termination points, removes ODUkp/ETH\_A and ODU2P/ETHPP-OS\_A, adds Annex A for the Ethernet Spec model.

**ITU-T G.8152/Y.1375 (revised) "Protocol-neutral management information model for the MPLS-TP network element"** contains the protocol neutral unified modelling language (UML) model for multi-protocol label switching – transport profile (MPLS-TP) network element (NE) management.

This Recommendation provides a representation of the MPLS-TP technology using the methodologies that have been used for other transport technologies (e.g., SDH, OTN and Ethernet).

The 2018 revision of this Recommendation up-versions the UML model tool to Papyrus v3.2.0 and the profile to 0.2.13. Updates the model to add the MEP proactive measurement MI, MEP configuration MI, and MIP configuration MI, add the Spec model for MPLS-TP model, replace the G.8152NE and MT\_NE by the MMPLS-TP Constraint Domain, and MT\_SubnetworkProtectionGroup specifies the FcSwitch, and MT\_CrossConnection specifies the ForwardingConstruct.

I.1.7 Ethernet over transport networks

I.1.8 MPLS over transport networks

**ITU-T G.8133 "Dual-Homing Protection for MPLS-TP Pseudowires"** provides architecture and mechanisms for Pseudowire (PW) dual-homing protection in MPLS transport profile (MPLS-TP) networks. It also describes the Dual-Homing Coordination (DHC) protocol defined in [IETF RFC 8184] and [IETF RFC 8185]. The mechanisms defined herein protect point-to-point MPLS-TP PWs against failures within or at the edges of the MPLS-TP network.

I.1.9 Synchronization and timing

**ITU-T G.8261/Y.1361 (revised) "Timing and synchronization aspects in packet networks"** defines frequency synchronization aspects in packet networks. It specifies the maximum network limits of jitter and wander that shall not be exceeded. It specifies the minimum equipment tolerance to jitter and wander that shall be provided at the boundary of these packet networks at TDM and synchronization interfaces. It also outlines the minimum requirements for the synchronization function of network elements. The requirements for the jitter and wander characteristics that are specified in this Recommendation must be adhered to in order to ensure interoperability of equipment produced by different manufacturers and a satisfactory network performance.

This revision to Recommendation ITU-T G.8261 (2013) provides the following updates:

− Addition of Clause 9.2.1.4 (Enhanced Synchronous Equipment Clock network limits)

− Addition of frequency requirements for LTE and NR to Appendix IV

− Addition of Appendix XIV.

**ITU-T G.8262.1/Y.1362.1 "Timing characteristics of enhanced synchronous equipment slave clock"** outlines requirements for timing devices used in synchronizing network equipment that uses the physical layer to deliver frequency synchronization. This Recommendation defines the requirements for clocks, e.g., bandwidth, frequency accuracy, holdover and noise generation.

**ITU-T G.8262.1/Y.1362.1 (01/2019) Amd.1 "Timing characteristics of enhanced synchronous equipment slave clock: Amendment 1"** outlines requirements for timing devices used in synchronizing network equipment that uses the physical layer to deliver frequency synchronization. This Recommendation defines the requirements for clocks, e.g., bandwidth, frequency accuracy, holdover and noise generation.

Amendment 1 to Recommendation ITU-T G.8262.1/Y.1362.1 (01/2019) provides the following updates:

− Adds requirements for clause 9.1

− Replaces clause 9.3.1 with a reference to clause 9.2.1 of [ITU-T G.8262].

− Adds "enhanced" to the "synchronous OTN interface" in clause 9.3.3

− Changes in Clause 11.1: defines parameter S; defines parameter T (except for OTN interfaces)

− Changes in Clause 11.2: define parameter a2; changes figure 8 to start at 15s.

− Adds "Synchronous OTN interfaces" in Clause 12

− Adds text to Appendix IV

− Adds Appendix V.

**ITU-T G.8265.1/Y.1365.1 Amd.1 "Precision time protocol telecom profile for frequency synchronization – Amendment 1"** makes the following changes:

− Add notes to the quality level to clockClass mappings table in clause 6.7.3.1.

**ITU-T G.8271.1 (10/2017) Amd.2 "Network limits for time synchronization in packet networks: Amendment 2"** 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 packet networks at phase and time synchronization interfaces. It also outlines the minimum requirements for the synchronization function of network elements. This Recommendation addresses the case of time and phase distribution across a network by a packet-based method with full timing support to the protocol level from the network.

Amendment 2 to Recommendation ITU-T G.8271.1 (10/2017) provides the following updates:

− Updated references

− Addition of information to Clause 7

− Revision of Appendix II

− Revision of Appendix VII

− Revision of Appendix XI

− New Appendix XII.

**ITU-T G.8271.2 Amd.2 "Network limits for time synchronization in packet networks with partial timing support from the network: Amendment 2"** provides the following updates:

− Replacement of Figure 2

− Addition of text to clauses 7.3.1.1 and 7.3.2.1

− Revision of clauses 7.4.1 and 7.4.2

− Replacement of Figures I.2 and I.4

− Revision of clauses I.3 and I.6

− Addition of new Appendix IV.

**ITU-T G.8272.1/Y.1367.1 Amd.2 "Timing characteristics of enhanced primary reference time clocks - Amendment 2"** provides the following updates:

− Added case where ePRTC includes an integrated T-GM clock.

**ITU-T G.8273.2/Y.1368.2 (revised) "Timing characteristics of telecom boundary clocks and telecom time slave clocks"** specifies minimum requirements for time and phase for telecom boundary clocks and telecom time slave clocks used in synchronization network equipment that operates in the network architecture as defined in Recommendations ITU-T G.8271, ITU-T G.8271.1, ITU-T G.8275 and ITU-T G.8275.1. It supports time and/or phase synchronization distribution for packet based networks.

This version of the Recommendation only applies to full timing support from the network.

These requirements apply under the normal environmental conditions specified for the equipment.

**ITU-T G.8273.2/Y.1368.2 Amd.2 "Timing characteristics of telecom boundary clocks and telecom time slave clocks - Amendment 2"** replaces text in the Scope, in clauses 2, 4, 7.1, 7.1.1, 7.1.2, 7.4.1.2, C.2.4.1.2, and in Annex B . It adds Annex D. It replaces text in Appendices I, II, and V. It replaces text, table and figure in Appendix III and VI.

**ITU-T G.8273.3/Y.1368.3 Amd.1 "Timing characteristics of telecom transparent clocks - Amendment 1"** changes the notes in clauses 7.1.1, 7.1.2 and 7.13. It also adds Appendix III.

**ITU-T G.8275/Y.1369 Amd.2 "Architecture and requirements for packet-based time and phase distribution - Amendment 2"** provides the following updates:

− Add a profile translation to Appendix III

− Add a functional model for cnPRTC to Appendix VI.

**ITU-T G.8275.1/Y.1369.1 Amd.3 "Precision time protocol telecom profile for phase/time synchronization with full timing support from the network - Amendment 3"** provides the following updates:

- G.8272.1 and G.8273.3 references added along with related supporting text

- Native OTN transport added to this profile.

**ITU-T G.8275.2/Y.1369.2 Amd.3 "Precision time protocol telecom profile for phase/time synchronization with partial timing support from the network - Amendment 3"** provides the following updates:

− G.8272.1 reference added

− Convention T-BC-P/A added as a concise way to refer to T-BC-P or T-BC-A

− Convention T-TSC-P/A added as a concise way to refer to T-TSC-P or T-TSC-A

− Added Appendix VIII Operations over link aggregation.

I.1.10 Cable

**ITU-T J.1 "Terms, definitions and acronyms for television and sound transmission and integrated broadband cable networks"** compiles all the definitions related to television and sound transmission, and integrated broadband cable networks, and which are in force in J-series and N-series Recommendations developed under the responsibility of SG9. The Recommendation is regularly updated to reflect newly-approved terms and definitions.

**ITU-T J.207 (revised) "Specification for integrated broadcast and broadband digital television application control framework"** was revised to update the information about the Hybridcast, HbbTV and Ginga according to the revision of Recommendation ITU-R BT.2075. As WP6B October 2018 meeting, proposed to revise the Recommendation ITU-R BT.2075 to update the information on device integration in the Hybridcast system, update of HbbTV and update of Ginga.

**ITU-T J.216 "Second-generation Modular Headend Architecture in systems for interactive cable television services - IP cable modems"** defines the second generation of headend architectures for high-speed data-over-cable systems. The second-generation of headend architecture introduces a number of new features that build upon what was present in previous Cabinet DOCSIS Recommendations [J.223.1] and [J.223.2]. This Recommendation includes key new features for the CMC III Device (also known as the Remote-PHY Device).

**ITU-T J.224 "Fifth-generation transmission systems for interactive cable television services - IP cable modems"** defines the fifth generation of high-speed data-over-cable systems. The fifth-generation transmission systems introduce a number of new features that build upon what was present in previous Recommendations [ITU-T J.112], [ITU-T J.122], [ITU-T J.222], and [ITU-T J.223]. This Recommendation includes key new features for the physical (PHY) layer and defines Full Duplex DOCSIS® Mode of operation, including enhancements to the media access control (MAC) layer protocols as well as requirements for upper layer protocols (e.g., IP, DHCP, etc.). The fifth-generation cable modem specifications fully incorporate the fourth generation specifications.

**ITU-T J.288 (revised) "Encapsulation of type length value (TLV) packet for cable transmission systems"** proposes an encapsulation scheme for type length value (TLV), a data structure specified in Recommendation ITU-R BT.1869, for cable transmission systems designed on the basis of Recommendation ITU-T J.83. Many of the existing digital broadcasting systems use the Motion Picture Experts Group version 2 (MPEG-2) transport stream (TS) as their input format. In contrast, variable-length packets formats such as TLV are specified for transmitting Internet protocol (IP) packets efficiently over broadcasting channels as aggregates of variable-length packets. In order to transmit TLV with the existing Recommendation ITU-T J.83 transmission system, it is necessary that variable-length TLV packets be fragmented and encapsulated into fixed-length 188-byte packets.

**ITU-T J.298 "Requirements and technical specifications of cable TV hybrid set-top box that has the compatibility with terrestrial and satellite TV transport"** describes the requirements and technical specifications of cable TV hybrid set-top-box that has the compatibility with terrestrial and satellite TV transport. The major purpose of the Recommendation is to specify a minimum and basic requirement for a hybrid STB, which meets the requirements for developing countries and regions .The hybrid set-top-box has full functionalities for traditional cable broadcasting services based on ITU-T Recommendation J.83, at the same time, a satellite or a terrestrial broadcast receiving functions will also be implemented in the box so as the STB be able to receive satellite or terrestrial broadcast service. The basic functionalities for IP-based interactive video services is also required so as the STB be able to support the latest IP interactive services together with legacy cable and satellite/terrestrial services.

**ITU-T J.302 (2016) Amd.1 "System specifications of augmented reality smart television service: Amendment 1"** supports real-time comment sharing services.

**ITU-T J.383 "Conversion of type length value (TLV) packet and transport stream for advanced cable transmission systems"** describes the conversion schemes of data structures defined in [ITU-R BO.2098-0] for cable television systems on the basis of [ITU-T J.382].

[ITU-R BO.2098-0] specifies two data structures, MPEG-2 TS and TLV. MPEG-2 TS data packets are directly transmitted while any transmission control signals and service information are transmitted using a descriptor specified in [ETSI TS 102 991]. TLV packets are not directly transmitted in TLV format but converted to GSE [6] packet format specified in [ITU-T J.382].

The EWS control signal specified in [ITU-R BO.2098-0] is also converted into physical layer signalling specified in [ITU-T J382], to wake up the receiver when the Emergency Warning System is activated.

**ITU-T J.1026 "Downloadable Conditional Access System for Unidirectional Network; Requirements"** specifies requirements for one-way downloadable conditional access system (DCAS) for unidirectional network. One-way DCAS protects broadcast content/services and controls consumer entitlements like traditional conditional access (CA) systems, and enables a terminal, such as a set-top-box (STB), to adapt to a new CA system by downloading and installing the new CA system's client without hardware changing. In particular one-way DCAS can fully work in unidirectional cable TV networks and other unidirectional networks such as satellite TV networks.

**ITU-T J.1027 "Downloadable Conditional Access System for Unidirectional Network; System Architecture"** specifies a system architecture for one-way downloadable conditional access system (DCAS) for unidirectional network. One-way DCAS protects broadcast content/services and controls consumer entitlements like traditional conditional access (CA) systems, and enables a terminal, such as a set-top-box (STB), to adapt to a new CA system by downloading and installing the new CA system's client without hardware changing. In particular one-way DCAS can fully work in unidirectional cable TV networks and other unidirectional networks such as satellite TV networks.

**ITU-T J.1028 "Downloadable Conditional Access System for Unidirectional Network; Terminal System"** specifies a terminal for one-way downloadable conditional access system (DCAS) for unidirectional network. One-way DCAS protects broadcast content/services and controls consumer entitlements like traditional conditional access (CA) systems, and enables a terminal, such as a set-top-box (STB), to adapt to a new CA system by downloading and installing the new CA system's client without hardware changing. In particular one-way DCAS can fully work in unidirectional cable TV networks and other unidirectional networks such as satellite TV networks.

**ITU-T J.1108 "Transmission specification for Radio over IP transmission system"** provides a cost-effective adaptable solution for HFC-based cable TV network devices in optic-based cable TV network. The purpose of RoIP system is to transmit Data Over Cable Service Interface Specifications (DOCSIS) based Up Stream (US) RF signal of Cable Modem (CM) to Cable Modem Termination System (CMTS) through IP transmission in optic-based cable TV network.

**ITU-T J.1109 "Requirement for in-band full-duplex in HFC based network"** describes the high level general and system requirements for in-band full duplex in HFC based network. The purpose of in-band full duplex in HFC based network is to develop simultaneous transmission and reception in the same band using HFC based cable TV network.

**ITU-T J.1201 "The functional requirements of smart TV operating system"** specifies the functional requirements of a smart TV operating system. The smart TV operating system is intended to be installed in IBB capable cable STB and TV and to enable broadcasting and IP-based interactive services provided by cable television operators and third-party providers. By running the smart TV operating system, the IBB capable cable STB and TV will be able to intelligently provide subscribers with advanced and personalized services by downloading and installing advanced and personalized Apps from cable operators' platforms and third-party platforms, which are interconnected with the related cable operators' platforms.

This Recommendation is the first Recommendation of a smart TV operating system series. The Recommendations for this smart TV operating system will cover functional requirements, architecture, security and APIs.

**ITU-T J.1202 "The Architecture of Smart TV Operating System"** defines the architecture of smart TV operating system to enable IBB capable cable STB and TV to apply to broadcasting services and IP-based interactive services provided by cable television operators and third-party providers. By running the smart TV operating system, the IBB capable STB and TV will be able to provide subscribers with advanced and personalized services by downloading and installing advanced and personalized Apps from cable operators' platforms and third-party platforms, which are interconnected with the related cable operators' platforms.

**ITU-T J.1210 "Requirements of IP Video Broadcast (IPVB) for CATV Networks"** specifies an IPVB technology, which simply adds a one-way IP-based video broadcast system to the existing low-cost bidirectional CATV networks (including both HFC and optical networks). The IPVB can greatly increase the bandwidth of downlink programs when using optical network, and at the same time, have the characteristics of low cost and low complexity. The IPVB in downlink transmits IP-based video streams through broadcast channels which are identified by multicast IP addresses and UDP port numbers, and broadcasts all the IP-based video streams through the CATV networks to all subscribers. By cooperating with the uplink channel provided by the existing bidirectional access networks, it is capable of providing varieties of IP-based high bitrate video services in CATV networks.'

**ITU-T J.1600 "Premium Cable Network Platform (PCNP) – Framework"** **(**under approval**)** specifies the framework of the Premium Cable Network Platform (PCNP) for the cable TV and broadband network that exploit the cloud based artificial intelligence and network data to optimize the network and TV services, thus enable the high satisfaction of user's experience of perceptual aspects of services.

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

**ITU-T H.643.1 "Architecture for deployment of information centric network"** describes the functional architecture for deployment of information centric network (DICN) including functional entities, reference points and service control flows. It also describes the required DICN capabilities. This architecture can be used to flexibly support the deployment of any particular information centric network (ICN) instances and the co-existence of multiple ICN instances in one physical network. It also facilitates the interoperation between different ICN instances. It will benefit the deployment of existing ICN protocols and enable the research and development of new ICN technology.

**ITU-T H.644.1 "Functional architecture for virtual content delivery networks"** describes a functional architecture for virtual content delivery network (VCDN). ITU-T Recommendation F.743.4 gives an overview and the requirements for virtual content delivery network (VCDN). This Recommendation focuses on functional architecture for VCDN. It specifies overall functional architecture, domains and functional role relationship, functional blocks, reference points, relations among physical resources, virtual resources, and LINPs (logically isolated network partition), functions and their mutual relations, and security considerations. VCDN can realize accurate infrastructure distribution and elastic resource scheduling. VCDN can integrate the resources of CDN, reduce construction cost and improve the scalability.

**ITU-T Q.3642 "IMS references to Release 12 for communication between IMS and NGN networks to support end-to-end service interoperability":** In general, the IMS implementation is based on the set of standards developed by different SDOs. In this regards, there is an intention to develop a recommendation which lists the references to specifications defining requirements for IMS to be used for the Non-roaming architecture for 3GPP accesses as base for the communication between IMS and NGN Networks in order to support the end-to-end service interoperability.

**ITU-T X.609.6 "Managed P2P communications: Content distribution signalling requirements"** specifies signalling requirements for content distribution services over managed P2P overlay network that is specified in ITU-T X.609. Content distribution over a managed P2P network provides flexible content management over existing overlay networks and also it enables contents providers to control accessing the overlay network. That is, the content provider can update the content to be distributed over an overlay network anytime, and every update will be applied to all peers in the overlay network. This Recommendation lists requirements for the related reference points that are defined in Recommendation ITU-T X.609 for providing content distribution services, and it also describes high-level procedures for content distribution service over managed P2P architecture and roles of the managed P2P components for the service.

**ITU-T X.609.7 "Managed P2P communications: Content distribution peer protocol"** specifies a content distribution peer protocol (CDPP) that runs on the interface among entities of managed P2P communications. CDPP is used to distribute one or more contents to a number of peers. Content distribution over traditional P2P communications has incurred various issues such as distribution of illegal content, uncontrollable participation, and synchronized distribution of the updated contents. Different from the content distribution over the traditional P2P communications which is not capable of providing manageability, the content distribution over managed P2P communications can be managed by content provider or service provider. In the content distribution over managed P2P communications, as an example, participation in an overlay network can be controlled so that only predefined peers can join the overlay network and distribute contents each other. In addition, content to be distributed over an overlay network can be updated anytime, and every update will be applied to all peers in the overlay network. The protocol is capable of managing content distribution under control of content provider or service provider. This Recommendation provides protocol operations, and message formats for content distribution over managed P2P network.

**ITU-T Y.2323 "Requirements and capabilities of orchestration in next generation network evolution"** provides the scenarios of the orchestration in NGNe, specifies the general requirements of the orchestration in NGNe, and also introduces its capabilities from the perspective of NGN evolution and the coordination of NGNs and the networks implemented by SDN and NFV technologies.

**ITU-T Y.2242 "Service function chaining in mobile network"** specifies a way to coordinate existing and ongoing works on service function chaining in mobile network (specified in [IETF RFC7665][IETF RFC 8300] and [b-ONF TS-027]) by introducing a chain orchestrator as a new entity. The Recommendation also covers the case when relevant network functions are virtualized. The objective of this document is to describe the requirements, architecture, functional entities, reference points and information flows of service function chaining in mobile networks.

**ITU-T Y.2243 "A service model for risk mitigation service based on networks":** A risk mitigation service based on networks monitors risk events, stores the data in real time and analyses the associated data. Furthermore, it may perform the analysis of plant disease risks, marine aquaculture risks, or livestock disease risks, and provide corresponding mitigation services. The service model for the risk mitigation based on networks described in this Recommendation covers real time data acquisition, monitoring of risk events, and provision of mitigation services for the identified risks.

**ITU-T Y.2620 "T interface for Public packet Telecommunication Data Network (PTDN)"** specifies public packet Telecommunication Data Network (PTDN), which is one of hierarchical data networks to meet requirements of future packet-based networks which reference interfaces are defined in ITU-T Recommendation Y.2613. This Recommendation identifies the T interface and its functions between PTDN edge devices and Address Translators (ADT). The functions, procedures for the two types, i.e. T1 interface and T2 interface, are described. Appendix I gives an example of encapsulation for T interface messages. Appendix II gives one candidate message format for address resolution in T1 interface.

**ITU-T Y.2774 "Functional requirements of deep packet inspection for future networks"** specifies the functional requirements of deep packet inspection for future networks (e.g., software defined networks (SDNs), network function virtualization (NFV), etc.). The scope of this Recommendation includes the general requirements of deep packet inspection (DPI) for future networks, DPI functional requirements for SDN, DPI functional requirements for NFV,DPI functional requirements for service function chain (SFC) and DPI as a service, as well as DPI functional requirements for network virtualization and DPI functional requirements for evolving mobile networks.

**ITU-T Y.2775 "Functional architecture of deep packet inspection for future networks"** specifies the functional architecture of deep packet inspection for future networks (e.g.., software defined networking, network function virtualization etc.). This Recommendation specifies general DPI functional architecture aspects related to future networks, DPI functional architecture for software defined networking, network function virtualization, service function chaining and DPI as a service, network virtualization, and evolving mobile network..

**ITU-T Y.2815 "Mobility supporting architecture for mobile Peer to Peer service in heterogeneous wireless networks"** specifies the mobility supporting architecture required for mobile P2P services in heterogeneous networks including cellular networks, WiMAX and WLAN. It covers the aspects related to functional requirements, and architecture, high-level information flows and security considerations for mobile P2P users.

I.2.3 IMT-2020/5G networks

**ITU-T Q.5020 "Protocol requirements and procedures for network slice lifecycle management"** describes the protocol requirements and procedures for network slice lifecycle management, including the reference signalling architecture, requirements, and protocol procedures.

**ITU-T Y.3072 "Requirements and Capabilities of Name Mapping and Resolution for Information Centric Networking in IMT-2020"** specifies the requirements and capabilities of name mapping and resolution to achieve high performance such as low latency and scalability for a massive number of named objects for information centric networking in IMT-2020. (1) It provides an introduction to name mapping and resolution in IMT-2020. (2) It describes service and functional requirements of name mapping and resolution. (3) Based on the requirements, it specifies the capabilities of name mapping and resolution for information centric networking in IMT-2020.

**ITU-T Y.3073 "Framework for service function chaining in information centric networking"** specifies the framework in applying information centric networking (ICN) to edge computing and service function chaining. It describes the communication models, messages and their content, and functional components and their interactions in applying ICN to service function chaining.

**ITU-T Y.3074 "Framework for directory service for management of huge number of heterogeneously named objects in IMT-2020"** introduces a directory service function in the IMT-2020 architecture. It describes the components of the directory service function that can store a huge volume of records associated with heterogeneous types of names of objects (i.e. devices and data), and that can provide a very low latency lookup service. It describes the general procedure of the directory service function to register, cache, lookup, update, and delete records.

**ITU-T Y.3104 "Architecture of the IMT-2020 network"** provides the architecture of the IMT-2020 network from a functional perspective. An architecture reference model of the IMT-2020 network and procedures of the IMT-2020 network basic services [ITU-T Y.3102] are specified.

**ITU-T Y.3105 "Requirements of capability exposure in the IMT-2020 network"** identifies requirements of capability exposure in the IMT-2020 network. In particular, it provides at first an overview and general aspects of capability exposure in the IMT-2020 network, and then identifies requirements for the following key network capabilities: network slicing management, edge computing, network data analytics, fixed and mobile convergence, and QoS capabilities. Related scenarios of capability exposure in the IMT-2020 network are provided in Appendix.

**ITU-T Y.3106 "QoS functional requirements for the IMT-2020 network"** specifies the QoS functional requirements for the International Mobile Telecommunications (IMT) 2020 network. This Recommendation first provides an overview of QoS requirements for IMT-2020. It then describes the high level QoS capabilities of the IMT-2020 network which include: QoS planning, QoS provisioning, QoS monitoring and QoS optimization. Based on these capabilities, this Recommendation specifies the QoS functional requirements for the IMT-2020 network.

**ITU-T Y.3107 "Functional architecture for QoS assurance management in the IMT-2020 network"** specifies the functional architecture for QoS assurance management in the International Mobile Telecommunications (IMT) 2020 network. This Recommendation first describes the functional architecture for QoS assurance management under the IMT-2020 network management and orchestration framework. It then specifies reference points between QoS functional entities and IMT-2020 network management and orchestration plane.

**ITU-T Y.3112 (revised) "Framework for the support of Multiple Network Slicing in the IMT-2020 network"** describes the concept of network slicing and use cases of multiple network slicing. The multiple network slicing enables a single device to simultaneously connect to different network slices. The use case describes the slice service type for indicating a specific network slice and the slice user group for precisely representing the network slice in terms of performance requirements and business models. This Recommendation also specifies the high-level requirements and high-level architecture for multiple network slicing in IMT-2020 network.

**ITU-T Y.3131 "Functional architecture for supporting fixed mobile convergence in IMT-2020 networks"** describes the functional architecture of fixed mobile convergence in IMT-2020 networks, which supports the requirements of network evolution and accommodates convergent services in fixed and mobile networks. This Recommendation presents the overview, framework and functional architecture for supporting fixed mobile convergence in IMT-2020 networks.

**ITU-T Y.3151 "High-level technical characteristics of network softwarization for IMT-2020 - part: SDN"**: With the advent of network slicing technology for IMT-2020, which is the most typical substantiation of the network softwarization approach, this Recommendation describes technical aspects of SDN part of network slice support, which assists in handling individual components of a network slice, and contains network infrastructure and its control/management [ITU-T Y.3150]. This Recommendation addresses the technical aspect of the SDN environment: architectural model, functionalities and interfaces. Especially, high-level specifications of SDN control interfaces are treated based on a standard of SDN control of transport networks [ITU-T G.7702].

**ITU-T Y.3152 "Advanced Data Plane Programmability for IMT-2020"**: Advanced data plane programmability (ADPP) as an underlying technology for network softwarization enhances SDN with more agility and flexibility to meet the requirements of IMT-2020 networks [ITU-T Y.3150]. Via the advanced data plane programmability technology, network operators benefit from a "top-down" design process by defining network processing behaviour in a high level language. In other words, the advanced data plane programmability enables network operators to define specific data plane protocol (including packet formats) and to support extended network functionalities. The advanced data plane programmability leads to flexibility and automation, which lets network operators fully exploit data plane resources to enable their network applications. This Recommendation specifies the requirements and architecture about advanced data plane programmability for IMT-2020.

**ITU-T Y.3172 "Architectural framework for machine learning in future networks including IMT-2020"** specifies an architectural framework for machine learning (ML) in future networks including IMT-2020. A set of architectural requirements and specific architectural components needed to satisfy these requirements are presented. These components include, but are not limited to, ML pipeline and ML management and orchestration functionalities. The integration of such components into future networks including IMT-2020 and guidelines for applying this architectural framework in a variety of technology-specific underlying networks are also described.

**ITU-T Y.3324 "Requirements and Architectural Framework for Autonomic Management and Control of IMT-2020 Networks"** specifies high-level and functional requirements and architecture of Autonomic Management and Control (AMC) for IMT-2020 networks. It also specifies interworking reference points between AMC and IMT-2020 management and orchestration architecture, and legacy NMS/OSS. In Appendix I, it describes a use case to realize the AMC architecture through ETSI GANA reference model.

**ITU-T Q.5021 "Protocol for managing capability exposure APIs in IMT-2020 network"** describes the protocol for managing capability exposure APIs in IMT2020 network. It includes signalling architecture, API management functions, signalling flows and their message format, and definition for management APIs. It also describes gap analysis and use cases for API management. This protocol can be used by network operators and third parties to manage capability exposure APIs.

I.2.4 Home networking

**ITU-T G.9960 (2018) Amd.1 "Unified high-speed wire-line based home networking transceivers - System architecture and physical layer specification: Amendment 1"** (under approval)belongs to the family of ITU-T G.996x Recommendations. Recommendation ITU-T G.9960 specifies the system architecture and physical (PHY) layer for wireline-based home networking transceivers which are capable of operating over premises' wiring, including inside telephone wiring, coaxial cable, and power-line wiring. It complements the data link layer (DLL) specification in Recommendation ITU-T G.9961, and the power spectral density (PSD) specification in Recommendation ITU-T G.9964. Amendment 1 includes the extension of the Recommendation to operate on an extended bandwidth over coaxial and phoneline mediums.

**ITU-T G.9961 (2018) Amd.1 "Unified high-speed wireline-based home networking transceivers – Data link layer specification: Amendment 1"** (under approval) belongs to the family of ITU-T G.996x Recommendations. Recommendation ITU-T G.9961 specifies the data link layer (DLL) for wireline-based home networking transceivers capable of operating over premises wiring including inside telephone wiring, coaxial cable, and power-line wiring. It complements the system architecture and physical (PHY) layer specification in Recommendation ITU-T G.9960, and the power spectral density (PSD) specification in Recommendation ITU-T G.9964.

Amendment 1 includes a new physical layer specification. This new physical layer provides new modulation mechanisms (e.g. Multi Level Coding) and Robust Communication Mode (RCM) and allows the system to be operated over an extended bandwidth for coaxial and phoneline mediums.

**ITU-T G.9991 "High speed indoor visible light communication transceiver – System architecture, physical layer and data link layer specification"** specifies the system architecture, physical (PHY) layer and data link layer (DLL) for high-speed indoor optical wireless communication transceiver using visible light.

**ITU-T G.9992 "Indoor optical camera communication transceiver – System architecture, physical layer and data link layer specification"** specifies the system architecture, physical (PHY) layer and data link layer (DLL) for indoor optical camera communication transceiver.

I.2.5 Smart Grid

I.2.6 Software-defined networking

**ITU-T Q.3717 "Signalling requirements for automatic management of IP address pool by SDN technologies on BNG"** describes the signalling requirements for the implementation of automatic management and efficient utilization of IP address resources using software defined networking technologies on broadband network gateways. The signalling is used to automatically implement allocation, monitor and reclaim of IP address resources.

**ITU-T Q.3718 "Signalling requirements of the Sew interface for Virtual Data Center"** focuses on the inter-domain Sew interface which is standardized to allow for multiple control entities within Virtual Data Center (VDC). In VDC, the SDN control entities exchanges the control plane related information with each other through the Sew interface.

I.2.7 Cloud computing

**ITU-T Y.3507 "Cloud computing – Functional requirements of physical machine"** provides the introduction of physical machine with physical machine components, physical machine types, virtualizations in physical machine as well as the scalability of components in physical machine. Also, the Recommendation provides functional requirements for physical machine derived from various use cases are described in Appendix. The relationship with other related specifications developed in other SDOs has also been introduced as Appendix.

**ITU-T Y.3508 "Cloud computing - Overview and high-level requirements of distributed cloud"** provides an overview and high-level requirements for distributed cloud. This Recommendation introduces the concept of the distributed cloud, and identifies the characteristics of distributed cloud. Based on concept and characteristics, configuration models are illustrated. Deployment considerations of distributed cloud are provided in perspective of infrastructure, network, service, management and security. From use cases, high-level requirements of the distributed cloud are derived.

**ITU-T Y.3517 "Cloud computing - Overview of inter-cloud trust management"** provides an overview of inter-cloud trust management by specifying isolation and security management mechanism, inter-cloud trust management model, reputation-based trust management in inter-cloud environment, cloud service evaluation framework and the relationship with cloud computing reference architecture. It also provides requirements for inter-cloud trust management derived from the corresponding use cases.

**ITU-T Y.3518 "Cloud computing - Functional requirements of inter-cloud data management"** provides the overview of inter-cloud data management and its functional requirements. It describes the typical use cases and specifies the functional requirements on three aspects, ranging from inter-cloud data policy, inter-cloud data isolation and protection, inter-cloud data management which are derived from the corresponding use cases.

**ITU-T Y.3523 "Metadata framework for NaaS service lifecycle management"** specifies the metadata framework for NaaS service lifecycle management in the closed loop automation environment. This Recommendation is the extension the Recommendation ITU-T Y.3512 and Recommendation ITU-T Y.3515 as the NaaS series Recommendations. It provides the metadata framework for NaaS service lifecycle management with the highlight on the NaaS service operational policy framework.

I.2.8 Big data

**ITU-T Y.3519 "Cloud computing - Functional architecture of big data as a service"** describes the functional architecture for big data as a service (BDaaS). The functional architecture is defined on the basis of the analysis of requirements and activities of cloud computing based big data described in ITU-T Y.3600. Following the methodology of ITU-T Y.3502, the BDaaS functional architecture is described from a set of functional components and cross-cutting aspects. The specified functional components consist of sets of functions that are required to perform the BDaaS activities for the roles and sub-roles described in ITU-T Y.3600.

**ITU-T Y.3602 "Big data – Functional requirements for data provenance"** describes a model and operations for big data provenance. Also, this Recommendation provides the functional requirements for big data service provider (BDSP) to manage big data provenance.

**ITU-T Y.3651 "Big-data-driven networking – mobile network traffic management and planning"** specifies some technology aspects related to big-data-driven networking – mobile network traffic management and planning. The research of this Recommendation includes: requirements, framework, reference points, performance aspects and security considerations of big-data-driven networking – mobile network traffic management and planning.

I.2.9 Network Management

**ITU-T M.3040 "Principles for on-site telecommunication smart maintenance"** introduces principles for on-site telecommunication smart maintenance (TSM). In this Recommendation, the background and basic concepts of on-site telecommunication smart maintenance are provided. This Recommendation also provides details of TSM architectures, including TSM functional architecture, TSM physical architecture, TSM information architecture, and maintenance processes.

I.3.1 Video and image coding

**ITU-T H.230 (revised) "Frame-synchronous control and indication signals for audiovisual systems":** Digital audiovisual services are provided by a transmission system in which the relevant signals are multiplexed onto a digital path using the frame structure defined in Recommendation ITU-T H.221. In addition to the audio, video, user data and telematic information, these signals include information for the proper functioning of the system. The additional information has been named control and indication (C&I) to reflect the fact that while some bits are genuinely for "control", causing a state change somewhere else in the system, others provide for indications to the users as to the functioning of the system. Recommendation ITU-T H.230 concerns only those C&I which must be transmission frame synchronous, or otherwise requiring rapid response.

This Recommendation details the C&I related to video and audio; means of transmitting numbers and characters; C&I for maintenance purposes; for simple multipoint conferences not using protocol in the MLP channel; for channel aggregation; and for the transfer of network addresses. The codepoint tables also indicate the circumstances under which the various functions may be mandatory or optional.

This revised version of Recommendation ITU-T H.230 introduces a number of clarifications and corrections to the previous version. Those corrections were listed in the Q11/16 and previous study period Q1/16 living lists. They mainly concern the definitions of C&I symbols.

**ITU-T H.243 (revised) "Procedures for establishing communication between three or more audiovisual terminals using digital channels up to 1920 kbit/s"** introduces a clarification to the contention resolution principle random number description. This clarification previously appeared in the Q1/16 living list and it is associated with the corrections and clarifications added to a revised version of H.230. This version also introduces some editorial corrections.

**ITU-T H.264 (V13) (revised) "Advanced video coding for generic audiovisual services"** contains the draft text for changes to the Advanced Video Coding (AVC) standard (Rec. ITU-T H.264 | ISO/IEC 14496-10) to specify additional supplemental enhancement information (SEI) messages for ambient viewing environment, content light level information, content colour volume, equirectangular projection, cubemap projection, sphere rotation, region-wise packing, omnidirectional viewport, SEI manifest, and SEI prefix, along with some corrections to the existing specification text.

This Recommendation was developed jointly with ISO/IEC JTC 1/SC 29/WG 11 (MPEG), 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 MPEG in technical alignment with the ninth (not yet published) edition of ISO/IEC 14496-10.

**ITU-T H.265 (V6) (revised) "High efficiency video coding"** includes the specification of additional Supplemental Enhancement Information (SEI) messages for SEI manifest and SEI prefix information, along with some corrections to the existing specification text.

This Recommendation was developed jointly with ISO/IEC JTC 1/SC 29/WG 11 (MPEG), 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 MPEG in technical alignment with the fourth (not yet published) edition of ISO/IEC 23008-2.

**ITU-T T.800 V3 (revised) (T.800 (2015) Cor1 & Amd1) "Information technology - JPEG 2000 image coding system: Core coding system"** defines a set of lossless (bit-preserving) and lossy compression methods for coding bi-level, continuous-tone grey-scale, palletized colour, or continuous-tone colour digital still images. This edition adds a profile marker segment, extended capabilities marker segment, and valid profile number values, and includes additional improvements of the basis text. This Recommendation was developed jointly with ISO/IEC JTC 1/SC 29/WG 1 (JPEG), and Rec. ITU-T T.800 is maintained as common text with ISO/IEC 15444-1. This edition corresponds to the fourth edition of ISO/IEC 15444-1. (Since this specification was published as common text only after the first edition had been approved by ISO/IEC JTC 1 in 2000, edition numbers in the ITU and ISO/IEC versions are offset by one.)

**ITU-T T.814 "Information technology - JPEG 2000 image coding system: High-throughput JPEG 2000"** 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. The HT block coding algorithm increases decoding and encoding throughput and allows mathematically lossless transcoding to and from the block coding algorithm of Rec. ITU-T T.800 | ISO/IEC 15444-1. This is achieved at the expense of some loss in coding efficiency and substantial elimination of quality scalability. This Recommendation was developed jointly with ISO/IEC JTC 1/SC 29/WG 1 (JPEG), and corresponds as common text with ISO/IEC 15444-15.

**ITU-T T.815 "Information technology - JPEG 2000 image coding system: Encapsulation of JPEG 2000 images into ISO/IEC 23008-12"**: 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.

**ITU-T T.832 (V4) (revised) "Information technology - JPEG XR image coding system - Image coding specification"** adds the specification of support for additional colour formats (particularly including those specified by Rec. ITU-R BT.2020 and Rec. ITU-R BT.2100) and support for JPEG XR image coding in the ISO/IEC 23008-12 file format.

This Recommendation was developed jointly with ISO/IEC JTC 1/SC 29/WG 1 (JPEG), and Rec. ITU-T T.832 is maintained as technically aligned twin text with ISO/IEC 29199-2. The technical changes in this edition were developed in a joint collaborative team with JPEG in technical alignment with the fourth (not yet published) edition of ISO/IEC 29199-2.

**ITU-T T.873 "Information technology - Digital compression and coding of continuous-tone still images: Reference Software"**: The ISO/IEC 10918 series defines guidelines and requirements for coding of continuous-tone still images. Recommendation ITU-T T.81 | ISO/IEC 10918-1, also known under the name JPEG, specifies the codestream format and the decoding process. It is designed primarily for compression of continuous-tone photographic content.

This document provides reference software for Recommendation ITU-T T.81 | ISO/IEC 10918-1. The software has been successfully compiled and tested on Linux and Windows operating systems and conforms to the decoder requirements set forth in Recommendation ITU-T T.83 | ISO/IEC 10918 2. It has also been tested for conformance to Recommendation ITU-T T.86 | ISO/IEC 10918 4 and ISO/IEC 18477-4. An electronic attachment to the Specification contains two source code packages for ITU-T T.81 | ISO/IEC 10918-1.

I.3.2 Intelligent, interoperable visual surveillance systems

**ITU-T H.626.5 "Architecture for intelligent visual surveillance systems"** defines an architecture of intelligent visual surveillance systems, including the functional architecture, entities, service flows and reference points. The intelligent visual surveillance system provides intelligent analysis capabilities and services for users based on the images and video streams from surveillance cameras through network. This Recommendation is based on ITU-T Recommendation F.743.1 "Requirements for intelligent visual surveillance".

I.3.3 IPTV and digital signage

**ITU-T H.783 (V2) (revised) "Digital signage: Audience measurement services"** specifies functional requirements, configuration and operations, and metadata for audience measurement services in digital signage. The configuration and operations are processed between audience measurement client and audience measurement aggregation. The metadata describes the detail data elements and structures on information used in the configuration and operations.

This revision adds the XML schema on the data structures for message delivery. The addition aims to widen applicability of the specifications at the price of easy XML validation.

**ITU-T H.784 "Digital signage: Display device control interface"** addresses the display device control interface between the display device and the DS client. The Recommendation introduces an overview of the display device control interface and describes the functions and procedures for controlling and configuring the display device through the interface.

I.3.4 Immersive live experience

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

**ITU-T G.191 (V6) (revised) "Software tools for speech and audio coding standardization"** provides source code for speech and audio processing modules for narrowband, wideband and super-wideband telephony applications. The set includes codecs, filters, noise generators, etc.

This revision introduces changes to the main body of ITU-T G.191 and to Annex A, which describes the ITU-T Software Tools (STL) containing a high-quality, portable C code library for speech processing applications. Annex B remains unchanged.

This new release of the STL, also known as STL2018, incorporates new basic operators to accommodate state-of-the-art processor architectures which supports wide accumulators, SIMD (Single Instruction Multiple Data) and VLIW (Very Long Instruction Word). Thus the new operators provides support for 64-bit accumulator, complex numbers, enhanced 32-bit operations and additional control code operators.

The software package was reworked to make it available as a truly open-source project and is therefore hosted on an open-source collaboration platform. The build toolchain is now using CMake to generate platform-dependent and tool-dependent build scripts as well as to execute regression tests for each module in the STL.

This Recommendation includes an electronic attachment containing STL2018 Software Tool Library and manual.

**ITU-T G.1028 (revised) "End-to-end quality of service for voice over 4G mobile networks"** provides guidelines concerning the key aspects impacting end-to-end performance of managed voice applications over LTE networks and how they can be properly assessed using current elements of knowledge.

Some typical end-to-end scenarios are described, involving cases with LTE access at both sides of the communication, or with a different access technology at one side (wireless or wireline access). These scenarios are based on typical reference connections defined in this Recommendation, composed of various segments, including: terminal, wireless access, backhaul network, core network. Considerations regarding the sharing of the budget of some key parameters and the location where they can be assessed across these segments are provided.

As far as the specific impact of the CSFB procedure on QoS is concerned, dedicated information and material is available in the companion Recommendation ITU-T G.1028.2 "Assessment of the LTE circuit switched fall back - impact on voice QoS".

**ITU-T G.1028.1 "End-to-end QoS for Video Telephony over 4G mobile networks"** provides guidelines concerning the key aspects impacting end-to-end performance of carrier-grade (in opposition to over-the-top approaches, which are outside of the scope here) conversational video services over LTE networks, also known as ViLTE, as defined by the GSMA. It more so identifies the preconditions for an optimally operating ViLTE network and in conclusion provides remedial measures that operators can leverage to address the associated impact of QoS degradations in the LTE network.

**ITU-T G.1028.2 "Assessment of the LTE circuit switched fall back - impact on voice QoS":** While the LTE circuit switched fall back (CSFB) can be considered as a procedure separated from voice service delivery over LTE, it has an impact on the QoS for the voice services and is therefore worth of attention and consideration. Indeed, operators have to make sure that clients purchasing LTE-capable devices must keep the level of QoS they used to have with their former 2G and 3G devices, even when VoLTE is not available (for any reason: network, device). Therefore, specific and complementary KPIs are proposed in this Recommendation, together with procedures for their assessment.

It should be noted that this Recommendation focuses only on the specific impact of CSFB, the information it contains must be considered as a complement to provision already provided in the Recommendation ITU-T G.1028: "End-to-end quality of service for voice over 4G mobile networks".

**ITU-T P.10/G.100 (2017) Amd. 1 "Vocabulary for performance, quality of service and quality of experience - Amendment 1: New definitions for inclusion in Recommendation ITU-T P.10/G.100"** is coordinated with a related revision to Recommendation ITU-T P.64 Determination of sensitivity/frequency characteristics of local telephone systems. Definitions for the terms ear cap and earpiece are included in Recommendation ITU-T P.10/G.100.

**ITU-T P.64 (revised) "Determination of sensitivity/frequency characteristics of local telephone systems"** is mainly concerned with electro-acoustical measurements required for supplying sensitivity/frequency characteristics suitable for use in calculating loudness ratings, or estimating other subjectivity-determined quantities. For this purpose, measurements under real conditions must form the basis. Artificial mouths and artificial ears must be used with due regard to obtaining good agreement between these measurements and those from real mouth and ear determinations. Measurements under real conditions are complicated, time-consuming and not reproducible with great precision.

This Recommendation describes measurement methods using recommended forms of artificial mouths and artificial ears (see Recommendations ITU-T P.51 and P.57).

This Recommendation applies mainly to local telephone systems (LTSs) with handset telephones; however, the principles also apply to other types of telephones.

Annexes D and E define handset positions to be used with HATS according to P.58 and P.57 type 3.2, 3.3 and 3.4 artificial ears. Allowance is given to placing the handset in a way which best represents its intended use.

Annex F describes correspondence between measurements using the loudness rating guard-ring position (LRGP) and the head and torso simulator (HATS) position.

**ITU-T P.340 Amd.2 "Transmission characteristics and speech quality parameters of hands-free terminals - Amendment 2"** replaces Annex B: Objective test methods for multi-talker scenarios, which was introduced in Rec. ITU-T P.340 (2000)/Amd.1 (10/2014).

**ITU-T P.700 "Calculation of loudness for speech communication"** describes a unified method required for calculating loudness, allowing comparison of narrow-band (300-3.4k Hz), wideband (100-8k Hz), super-wideband (50-14k Hz) and Fullband (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 (handset, headset, hands-free …) with regards to producing a constant perceived loudness.

Compered to loudness rating models, like the one presented in Recommendation 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.811 "Subjective test methodology for evaluating Speech oriented stereo communication systems over headphones"** describes a methodology for evaluating the subjective quality of signal and spatial localization in stereo telecommunication systems. The methodology assesses the quality of the stereo transmission chain using separate subjective rating scales to independently estimate the subjective quality of a Signal, the Spatial Localization, and the Overall Quality.

**ITU-T P.863.1 (revised) "Application guide for Recommendation ITU-T P.863"** provides important remarks that should be taken into account in the objective quality evaluation of speech conforming to Recommendation ITU-T P.863. Users of ITU-T P.863 should understand and follow the guidance given in this Recommendation.

This Recommendation is a supplementary guide for users of Recommendation ITU-T P.863, which describes a means of estimating listening speech quality by using reference and degraded speech samples. The scope of Recommendation ITU-T P.863 is clearly defined in itself. This Recommendation does not extend or narrow that scope; rather, it provides necessary and important information for obtaining stable, reliable and meaningful objective measurement results in practice.

**ITU-T P.917 "Subjective test methodology for assessing impact of initial loading delay on user experience"** defines a procedure for conducting behavioral studies targeted at investigating video streaming performance and its relation to users' Quality of Experience. The studies are to be conducted in controlled environments. Subjects are exposed to different initial loading delay conditions and other quality degradations typical for video streaming, and may be asked to rate audiovisual quality or their experience. Additionally, their behavior as a response to long loading times (i.e., aborting the video playback during its loading phase) may be investigated.

**ITU-T P.1100 (revised) "Narrowband hands-free communication in motor vehicles"** describes performance requirements and test methods for narrowband hands-free communication in vehicles. This Recommendation covers:

– built-in hands-free systems,

– after-market hands-free car kits,

– corded headsets, and

– wireless headsets,

to be used in vehicles for communication while driving.

This Recommendation addresses the test of complete systems, as well as the subsystems of hands-free microphones and telephones with short-range wireless transmission links used to interconnect the hands-free system to the mobile network. For testing, the test set-up and the recommended environmental conditions are described. The methods, analysis and performance parameters described in this Recommendation are based on test signals and test procedures defined in Recommendations ITU-T P.501, ITU-T P.502, ITU-T P.340 and ITU-T P.380.

**ITU-T P.1203.1 (revised) "Parametric bitstream-based quality assessment of progressive download and adaptive audiovisual streaming services over reliable transport - Video quality estimation module"** specifies the short-term video representation quality estimation modules for ITU-T P.1203 (Pv module). The ITU-T P.1203-series of Recommendations specifies modules for a set of model algorithms for monitoring the integral media session quality for transport control protocol (TCP) type video streaming. The models comprise modules for short-term video-quality (described in this part of the Recommendation family) and audio-quality estimation. The per-one-second outputs of these short-term modules are integrated into estimates of audio-visual quality and together with information about initial loading delay and media playout stalling events, they are further integrated into the final model output, to provide an estimate of integral quality. The respective ITU-T work item has formerly been referred to as "Parametric non-intrusive assessment of TCP-based multimedia streaming quality", or "P.NATS". The ITU-T P.1203.1 part of ITU-T P.1203 provides details for the modules for bitstream-based, short-term video quality estimation.

Four different modes can be used for the Pv module specified in this Recommendation. These modes – referred to as mode 0 to 3 – use input information of differing complexity and amount and represent four model algorithms each with a different level of complexity. The Pv modules comprise components reflecting the effects due to video compression, up-scaling of content and the effect due to low frame rates. The four different modes use the same overall model architecture and individual coefficients and all have the same components for up-scaling and framerate. The only Pv module component that differs between modes is the Pv module component related to video compression.

This revision to Recommendation ITU-T P.1203.1 (10/2007) replaces the scale factor defined in clause 8.

**ITU-T P.1203.3 (revised) "Parametric bitstream-based quality assessment of progressive download and adaptive audiovisual streaming services over reliable transport - Quality integration module"** specifies the quality integration module for Recommendation ITU-T P.1203. The ITU-T P.1203 series of ITU-T Recommendations specify modules for monitoring the audio, video and audiovisual quality of video services such as adaptive bit-rate video streaming. The respective ITU-T work item has formerly been referred to as P.NATS (parametric non-intrusive assessment of TCP-based multimedia streaming quality). The ITU-T P.1203.3 part of Recommendation ITU-T P.1203 can be applied to the monitoring of performance and quality of experience (QoE) of video services such as adaptive bit-rate video streaming. Besides stream-based input information, the ITU-T P.1203.3 quality integration module takes the per-one-second video- and audio-quality scores calculated according to ITU-T P.1203.1 and ITU-T P.1203.2, respectively, as input.

Only one quality integration module is recommended for all four modes 0 to 3 of the Recommendation ITU-T P.1203 model series, unique across all modes. This Recommendation includes an electronic attachment containing the 20 trees described in clause 8.4. This revision to Recommendation ITU-T P.1203.3 (10/2007) replaces equation (20) in clause 8.3.

**ITU-T Y.1540 (revised) "Internet protocol data communication service - IP packet transfer and availability performance parameters"** defines parameters that may be used in specifying and assessing the performance of speed, accuracy, dependability and availability of IP packet transfer of regional and international Internet protocol (IP) data communication services. The defined parameters apply to end-to-end, point-to-point IP service and to the network portions that provide, or contribute to the provision of, such service in accordance with the normative references specified in clause 2. Connectionless transport is a distinguishing aspect of the IP service that is considered in this Recommendation.

Following over 20 years as an in-force Recommendation, the 2019 Edition recognizes many changes in the design of IP services and in the protocols employed by end-users. It introduces the new Annex A that defines IP Capacity parameters in ways that cater toward assessment, and provides requirements for methods of measurement of IP Capacity. This new Annex is the result of years of study, and application of ITU-T Study Group 12 principles of accurately evaluating performance parameters and methods of measurement against a "ground truth" reference in laboratory and field measurements.

**ITU-T Y.1550 "Considerations for Realizing Virtual Measurement Systems"** makes recommendations in key areas such as On-Demand Deployment and Accuracy Considerations. Development of virtualized measurement systems in areas highly relevant to SG12 work are in the early stages, so this Recommendation is timely.

I.3.6 New services and applications

**ITU-T F.743.7 "Requirements for big data enhanced visual surveillance services"** defines requirements for big data enhanced visual surveillance service. It promotes the value of visual surveillance service by using big data analytics method and tools. Massive data of video, event and sensing are analysed to support enhanced visual surveillance service including video retrieval, event detection and status prediction.

This Recommendation provides application scenarios, service requirements, functional requirements, performance and security requirements for big data enhanced visual surveillance service.

**ITU-T F.743.8 "Requirements for cloud computing platform supporting a visual surveillance system"** defines the requirements for cloud computing platform supporting visual surveillance system. Cloud computing is an emerging technology aimed at providing various computing services over the Internet. With the virtualization technology, cloud computing platform realizes a ubiquitous and flexible shared resources pool which can be rapidly provisioned and released with minimal management effort or service-provider interaction based on the needs of users. By using the cloud computing technology, the visual surveillance system can conveniently manage various functional components and services, such as video distribution, video transcoding, and intelligent video processing. This Recommendation provides the application scenarios and the requirements for cloud computing platform supporting visual surveillance system.

**ITU-T F.743.9 "Use-cases and requirements for multimedia CDN"** illustrates content delivery network, and defines the use cases for multimedia CDN in two categories: content delivery and capability use cases, as well as the requirements for CDN.

This Recommendation is intended to give the references for CDN providers and the customers of CDN when they build the infrastructures of a CDN or choose to use a CDN.

**ITU-T F.746.9 "Requirements and architecture for indoor conversational robot system"** defines requirements and architecture for in-door conversational robot system. In-door conversational robot system is one of the Artificial Intelligence applications equipped with speech interface that enables users to have a dialog with the robot. This recommendation defines requirements, architecture and functions for in-door conversational robot system. The scope of this Recommendation is focused on architecture, terminals, servers, and interfaces among modules. This Recommendation will allow users of the in-door conversational robot system to be able to experience convenient information services in various areas with user-friendly speech-dialog interfaces.

**ITU-T F.749.10 "Requirements for communication service of civilian unmanned aerial vehicle"** specifies requirements for communication services of civilian unmanned aerial vehicle (CUAV), including general communication service framework, communication system requirements, requirements for flight control communication and flight data transport, and requirements for mission payload communication service (such as audio / video / images transport, sensor data transport and communication signal relay). Use cases are presented in industry and consumer application areas such as agriculture and plant protection, power line and petroleum pipeline inspection, police & traffic security surveillance, natural disaster monitoring, aerial photography & video, logistics express delivery, meteorological, resource and science research, etc. This Recommendation provides communication service requirements behind all kinds of CUAV applications.

I.4.1 Internet of Things and Smart City

**ITU-T Y.4051 "Vocabulary for smart cities and communities"** contains vocabulary applied to smart cities and communities (SC&C) works. Basically, the terms and definitions in this vocabulary are defined in published Recommendations and Supplements of ITU and published standards of other international SDOs (such as ISO and IEC, etc.). Additionally, this vocabulary also includes some new terms and definitions to meet the needs of SC&C works of ITU.

**ITU-T Y.4202 "Framework of wireless power transmission application service"** defines a framework for Wireless Power Transmission (WPT) application service by describing concept, functional model, requirements, basic service flows and use cases.

**ITU-T Y.4203 "Requirements of things description in the Internet of things"** specifies requirements for an effective way of representing things as far as possible in a homogeneous way. The focus of the document is on the following two concerns of things description.

• Representing physical things as virtual things to map the physical things into information world;

• Representing the relationship of virtual things to reflect the relationship of the represented physical things

The corresponding requirements of things description in the IoT are specified, including:

• High level requirements of things description in IoT

• Requirements on the characterization aspects of things description in IoT

This Recommendation may be relevant for the matters addressed by ITU-T Y.4114 "Specific requirements and capabilities of the Internet of things for big data", e.g. semantic related data processing.

**ITU-T Y.4204 "Accessibility requirements for the Internet of things applications and services"** provides accessibility requirements specific to Internet of Things (IoT) applications and services. Benefits of accessible IoT applications and services are addressed, and accessibility requirements for IoT applications and services for persons with disabilities, persons with age related disabilities and those with specific needs to utilize the benefits of IoT applications and services, are specified. Some use cases are also provided in the Appendix to illustrate the need for IoT accessibility. This Recommendation complements existing Recommendations specifically defined for certain platforms in case such platforms are applied in the IoT context.

**ITU-T Y.4205 "Requirements and reference model of IoT-related crowdsourced systems"** introduces the concept of crowdsourced systems, as well as the reference model of IoT-related crowdsourced systems for the support of IoT applications and services to be provided via systems employing crowdsourcing principles. It addresses IoT-related crowdsourced systems in terms of functional requirements, reference model as well as identifying relevant security, privacy and trust issues. In particular, the main contributions can be summarized as follows:

- It identifies and provides the motivation for IoT-related crowdsourced systems (recent technological advancements and relevant emerging trends).

- It provides definitions of terms that are central when discussing crowdsourcing and srowdsourced systems, thus providing a basis of common understanding. So far, such terms have been used in layman's terms, outside a formal standardised framework; a practice which has led to ambiguity hindering further development of such systems. It is worth noting that the said definitions have been elicited via a rigorous methodology from a plethora of publications (both by academia and the industry); more information can be found in the body of this Recommendation.

- It provides a high-level reference model identifying the key layers and components of crowdsourced systems. The model does not dictate nor indicates a specific implementation or approach for building IoT-related crowdsourced systems. On the contrary, it provides a nominal model that facilitates the design and development of such systems by providing a common basis of reference.

**ITU-T Y.4206 "Requirements and capabilities of user-centric work space service":** User-centric work space (UCS) service is a service capable of providing a personalized work space to its service users by orchestrating local and/or remote ICT resources [ITU-T Y.Suppl.42]. Based on the use cases of UCS service addressed by [ITU-T Y.Suppl.42], this Recommendation provides the requirements and capabilities of UCS service. The provided requirements and capabilities are necessary to implement various types of UCS services.

**ITU-T Y.4207 "Requirements and capability framework of smart environmental monitoring"** provides the requirements and capability framework of smart environmental monitoring (SEM). As a smart application of Internet of Things (IoT) in the field of environmental monitoring and protection, SEM is an important means to enhance environmental management level and develop environmental protection. The provided requirements and capability framework are intended to be generally applicable in environmental monitoring.

**ITU-T Y.4458 "Requirements and functional architecture of smart street light service"** specifies requirements and the functional architecture of smart street light (SSL) service. Related use cases of SSL service are provided in Appendix I.

**ITU-T Y.4459 "An architecture for IoT interoperability"** (under approval)introduces the Digital Object Architecture (DOA) and its prospective in addressing security and interoperability among IoT applications.

DOA defines a framework for information-oriented services that makes use of existing infrastructures including Internet infrastructure to enhance secure and managed information sharing over a distributed networking environment. It defines framework for information management based on the use of digital object, and a common set of secure services that will help the registration, discovery, resolution, and dissemination of such digital objects. The set of DOA services is designed to facilitate sharing across any storage boundaries, any heterogeneous application boundaries, and any organization boundaries.

DOA defines a minimum set of needed architectural components, protocols, and services to provide a generic information and service interoperability. It will facilitate the interoperability of identification, description, representation, access, storage and security of IoT devices. DOA encourages a common security and management interface across different IoT applications. Under DOA, information represented in digital form is structured as Digital Objects (DOs), each of which has an associated unique identifier, which targeted to be persistent. However, metadata contained in the DOs (e.g. location of the object) could be updated without changing its identifier.

The identifier allows the DOs to be identified and discovered, regardless where they are located or stored. DOs are not confined within any particular application boundary and may be moved from host to host, accessed from application to application, shared from organization to organization, without losing its ownership or management control, in order to enhance interoperability. The DO's data model allows ownership and access control information to be defined by data owners independent of any specific applications. DOA can be used in line with different identification and addressing protocols (e.g. IP and/or non IP based networks).

**ITU-T Y.4460 "Architectural reference models of devices for IoT applications":** Processing power and communication capabilities define how the device communicates and interacts with other entities in an IoT solution. By correlating the processing and communication capabilities classifications, it is possible to enumerate three types of devices:

• Low processing and low connectivity device - LPLC device;

• Low processing and high connectivity device - LPHC device;

• High processing and high connectivity device - HPHC device.

This Recommendation describes the architectural reference models of devices for IoT applications, based on a classification of devices defined by processing power and communication capabilities. The architectural reference models described also includes the device's functional entities and the functional entities interaction for each device's architectural reference model.

Note: Devices with no processing capabilities are also not considered on this Recommendation because they are simple devices (ID Tags) that were defined on ITU-T Y.2213.

**ITU-T Y.4555 "Service functionalities of self-quantification over Internet of things"** describes service functionalities of self-quantification over Internet of things. It clarifies the concept of self-quantification services, identifies their considerations, and specifies their requirements and functionalities.

**ITU-T Y.4556 "Requirements and functional architecture of smart residential community"** (under approval)presents the key components and specifies requirements and the functional architecture of smart residential community (SRC).

**ITU-T Y.4904 "Smart sustainable cities maturity model"** (under approval) contains a maturity model for smart sustainable cities. This maturity model helps identify the goals, levels and key measures that are recommended for cities to effectively examine their current situation and determine critical capabilities needed to progress toward the long-term goal of becoming SSCs.

**ITU-T Y.4905 "Smart sustainable city impact assessment"** is a holistic impact framework for assessment for smart and sustainable cities to address effects of digital innovation on social, economic, and environmental issues. Smart sustainable city (SSC) initiatives have been proposed as potential solutions to economic, social and environmental challenges and pressures encountered by cities. Advances in Information and Communication Technologies (ICTs) enable significant transformation potential in the way city resources, services and infrastructures are planned and managed. More specifically, ICT can play an enabling role to address the urban challenges of 21st century. SSCs harness ICTs (including various subtopics under ICT such as digital transformation, data, IoT, digital services, etc.) and intend to deliver city enhancements through a portfolio of action items. By their very nature, SSC initiatives impact the underlying cities. It is important to identify and asses this impact. Identification and assessment of impact will allow better planning, setting expectations with stakeholders, better informed budgeting, more effective public private partnerships, and promotion of alternative financing mechanisms. This will also help in communicating SSC initiatives.

**ITU-T Y.4906 "Assessment framework for digital transformation of sectors in smart cities"** : The ultimate objective of this recommendation is to enhance the sustainability of identified priority sectors in smart cities, in order to optimise economic, environmental and social benefits. Cities will decide on their digital transformation priorities. For example, cities might also want to encourage collaboration to deliver desired outcomes. This kind of engagement based on the assessment framework can incentivize industry engagement and investment.

**ITU-T Y.Sup.52 to ITU-T Y.4000 series "Methodology for building digital capabilities during enterprises' digital transformation":** This methodology can help enterprises to address the challenges of integrating ICT applications into business activities to enhance the digital capability during digital transformation. and achieve the following during their digital transformation:

– making full use of ICTs to optimize business processes, improve organizational efficiency and strengthen the utilization of data resources;

– ensuring that ICT applications become consistent and coordinated with enterprises' strategies;

– using ICTs to build digital capabilities can increase the enterprises' economic benefits.

**ITU-T Y.Sup.53 to ITU-T Y.4000 series "IoT Use Cases":** Provides use cases related to different application domains of the Internet of Things.

**ITU-T Y.Sup.54 to ITU-T Y.4000 series "Framework for Home Environment Profiles and Levels of IoT Systems":** establishes a set of data fields that reflect consumer preferences for IoT‑enabled devices in specific environments. These data fields could be incorporated into a consumer device, stored in some fashion, and used by compatible IoT devices in the home and elsewhere to automatically implement those preset user preferences.

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

I.4.5 Connected health: e-Health

**ITU-T T F.780.1 "Framework for telemedicine systems using ultra-high definition imaging"** describes requirements for using ultra-high definition (UHD) imaging, such as 4K and 8K video, for telemedicine. The purpose of these requirements is to use UHD systems as part of endoscope and/or microsope for medical practices. This document also describes a list of requirements for using a UHD-based "endosopic video camera" as a medical device. In addition, Annex A describes the requirements on the use of this technology as a medical device.

**ITU-T H.846 (revised) "Conformance of ITU-T H.810 personal health system: Personal Health Devices interface Part 6: Device specializations: Personal Health Gateway"** provides a test suite structure (TSS) and the test purposes (TP) for Personal Health Gateways in the Personal Health Devices (PHD) interface, based on the requirements defined in the Recommendations of the ITU-T H.810 sub-series, of which Recommendation ITU-T H.810 (2017) is the base Recommendation. The objective of this test specification is to provide a high probability of interoperability at this interface.

Recommendation ITU-T H.846 is a transposition of Continua Test Tool DG2016, Test Suite Structure & Test Purposes, Personal Health Devices Interface; Part 6: Device Specializations. Personal Health Gateway (Version 1.9, 2016-09-20), that was developed by the Personal Connected Health Alliance. A number of versions of this specification existed before transposition.

This Recommendation includes an electronic attachment with the protocol implementation conformance statements (PICS) and the protocol implementation extra information for testing (PIXIT) required for the implementation of Annex A.

This revision includes the Power Status Monitor of Personal Health Devices device specialization (ISO/IEEE 11073-10427:2018) test cases as well as minor corrections.

**ITU-T H.849 (revised) "Conformance of ITU-T H.810 personal health system: Personal Health Devices interface Part 9: Transcoding for Bluetooth Low Energy: Personal Health Devices"** provides a test suite structure (TSS) and the test purposes (TP) for the transcoding by personal health devices in the Personal Health Devices (PHD) interface of application-level data between the Bluetooth Low Energy Bluetooth Generic Attribute Profile format and the IEEE 11073-20601 data format, based on the requirements defined in the Recommendations of the ITU T H.810 sub-series, of which Recommendation ITU-T H.810 (2017) is the base Recommendation. The objective of this test specification is to provide a high probability of interoperability at this interface.

Recommendation ITU-T H.849 is a transposition of Continua Test Tool DG2016, Test Suite Structure & Test Purposes, Personal Health Devices Interface; Part 9: PHD Transcoding Whitepaper. Personal Health Device BLE (Version 1.6, 2016-09-20), that was developed by the Personal Connected Health Alliance. A number of versions of this specification existed before transposition.

This Recommendation includes an electronic attachment with the protocol implementation conformance statements (PICS) and the protocol implementation extra information for testing (PIXIT) required for the implementation of Annex A.

This revision provides updates account for the inclusion of pulse oximeter and continuous glucose monitoring Bluetooth Low Energy profile test cases.

**ITU-T H.871 "Safe listening guidelines for personal sound amplifiers"** complements recommendation ITU-T H.870 "Guidelines for safe listening devices/systems": There is currently no international standard for Personal Sound Amplifiers (PSAs), which is needed to ensure these devices are safe for the user and do not further damage the users hearing, since they are freely available to anyone.

Personal Sound Amplifiers (PSAs) are non-medical devices, intended for people with normal hearing and (a) can have a design physically comparable to hearing aids, in which case it is called Personal Sound Amplification Product (PSAP) or (b) can also simply be an app on any smartphone or other device, in which case it is called Personal Sound Amplification App (PSAA).

As is defined in H.870, the sound exposure should be limited to an accumulated dose (100 % CSD) over 7 days of in total 1.6 Pa2h which corresponds to 80 dBA for 40 hours to prevent noise induced hearing loss. When the 100% CSD is reached, the sound level should suddenly drop, and the user will get the suggestion to lower the sound level, since the weekly sound listening dose is exceeded.

When PSAPs and PSAAs do not have the capacity to measure CSD, the output level of the device needs to be permanently limited to 95 dBA, so that the user is unlikely to use the device at a level higher than 80 dBA, since the dynamic range of speech has a crest factor of 12 to 17 dB.

I.5.1 New security standards

**ITU-T X.1042 "Security services using the software-defined networking"** supports the protection of network resources using security services based on software-defined networking (SDN). This Recommendation first classifies the network resources for SDN-based security services: SDN application, SDN controller, SDN switch and security manager (SM). This Recommendation then defines security services based on SDN.

**ITU-T X.1043 "Security framework and requirements of service function chain based on software-defined networking"** analyses security threats to the software-defined networking (SDN) based service function chain (SFC) and defines security requirements. The corresponding security countermeasures are also given. This Recommendation helps the reader to understand the security risks encountered when using the SDN-based SFC and further help to develop and implement secure service chain architecture.

**ITU-T X.1093 "Telebiometric access control with smart ID cards"** describes the general scheme for logical and/or physical access control using the biometrics-on-card. This Recommendation can be applied to the recent emerging area of requiring secure physical and also logical access control management.

**ITU-T X.1094 "Telebiometric authentication using biosignals"**: Biometric technology in mobile devices is frequently used in various areas that require a high level of reliability, such as smart car, e-banking, e-payment, telemedicine and e-healthcare services. In particular, it is necessary to implement countermeasures, which can pre-emptively cope with fake physiological biometrics to ensure mobile telebiometric data security to presentation attacks. Therefore, Recommendation ITU-T X.1094 specifies new secure and strong telebiometric authentication methods using biosignals.

**ITU-T X.1147 "Security requirements and framework for big data analytics in mobile Internet services"** mainly analyse the security requirements of big data analytics in mobile Internet services, and provide security framework.

**ITU-T X.1215 "Use Cases for Structured Threat Information Expression (STIX)"** provides various use cases for how the STIX language may be used to support cyber threat intelligence and information sharing. This Recommendation also describes concepts and functionality of Structured Threat Information Expression (STIX). It is targeted to support a range of use cases involved in cyber threat management, including analysing cyber threats, specifying indicator patterns for cyber threats, managing response activities, and sharing cyber threat information. Given this kind of information, a security decision can be made on how to best defend against the threat. It is intended to support both more effective analysis and the continued exchange of cyber threat information. The STIX suite of specifications is maintained under the responsibility of OASIS. See <https://www.oasis-open.org/committees/tc_home.php?wg_abbrev=cti>

**ITU-T X.1249 "Technical framework for countering mobile in-application advertising spam"** provides a technical framework for countering mobile in application advertising spam. Mobile in-application advertising spam is the sending of unsolicited advertisements, which are displayed within a mobile phone application. This unsolicited advertising can appear on the display screen of a mobile device as a banner at the top or bottom of the screen, a mobile interstitial, or an overlay. Along with the rapidly increasing development of mobile applications, mobile in-application advertisement has been surging dramatically. Filtering malicious advertisements may improve the user experience and even security. Therefore, it may be beneficial to establish a practical framework for countering mobile in-application advertising spam, which can reasonably integrate the advantages of all countermeasures.

**ITU-T X.1277 "FIDO Universal Authentication Framework (UAF)"** enables online services and websites, whether on the open Internet or within enterprises, to transparently leverage native security features of end-user computing devices for strong user authentication and to reduce the problems associated with creating and remembering many online credentials.

**ITU-T X.1278 "Client To Authenticator Protocol/Universal 2-factor framework"** describes an application layer protocol for communication between an external authenticator and another client/platform, as well as bindings of this application protocol to a variety of transport protocols using different physical media.

**ITU-T X.Suppl.34 – Supplement 34 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"** highlights and shares the implementation of code of practice for information and network security management by Malaysian information and communication industry based on ITU-T X.1051. The sets of requirements have been identified and documented in the "Requirements for Information and Network Security (INS)" developed by MTSFB and approved by MCMC on 5 October 2016. The requirements are based on ITU-T X.1051 for establishing, implementing, maintaining and continually improving an information and network security management within the context of an organization. The code of practice for information security controls based on ITU-T X.1051 for Malaysian telecommunication organizations provide four (4) families of control focusing on organization, infrastructure, people and environment.

**ITU-T Y.3800 "Framework for Networks supporting Quantum Key Distribution**" (under approval) specifies a framework for networks supporting quantum key distribution (QKD). This Recommendation provides support for design, deployment, operation and maintenance to implement QKD technologies with user networks in terms of opened and standardized technologies. In this Recommendation, the relevant network aspects for main structure, layered model and basic functions are within the scope of the Recommendation to support its implementation.

I.5.2 Trust

**ITU-T Y.3053 "Trustworthy networking deployment architecture and procedure – Amendment 1"** contains modifications to add trustworthy networking deployment architecture and procedures for IP networks in the Internet.

**ITU-T Y.3053 (2018) Amd.1 "Framework of trustworthy networking with trust-centric network domains: Amendment 1 - Trustworthy networking deployment architecture and procedures"** contains modifications to add trustworthy networking deployment architecture and procedures for IP networks in the Internet.

I.6.1 Green ICT standards

**ITU-T L.1000 (revised) "Universal power adapter and charger solution for mobile terminals and other hand-held ICT devices"** provides high level requirements for a universal power adapter and charger solution that will reduce the number of power adapters and chargers produced and recycled by widening their application to more devices and increasing their lifetime. The solution also aims to reduce energy consumption. The longer life cycle and possibility of avoiding device duplication reduces the demand on raw materials and waste. The universal power adapter and charger solution is designed to serve the vast majority of mobile terminals and other ICT devices.

**ITU-T L.1015 "Criteria for evaluation of the environmental impact of mobile phones"** focuses on the criteria to be used for evaluation of the environmental impact of mobile phones. It considers all life cycle stages of mobile phones such as the design, production, use and end of life management. The Recommendation also defines a minimum level of environmental performance. Within the constraints of technology and affordability, sustainability should be considered for: materials; energy use; durability, upgrade and repair operations; end of life management; packaging, corporate practice; manufacturing and operations.

**ITU-T L.1022 "Circular Economy: Definitions and concepts for material efficiency for Information and Communication Technology"** (under approval) contains a guide to circular economy (CE) aspects, parameters, metrics, indicators for information and communication technology (ICT) based on current approaches, concepts and metrics of the CE as defined in existing standards, while considering their applicability for ICT.

In this Recommendation ICT is defined as based on OECD [b-ISIC].

This Recommendation discusses the special considerations and challenges in a broader and more in depth context for all ICT defining parameters, metrics, and indicators with the intention to guide the vertical standardization of the material efficiency for ICT. The guideline aims to examine the kinds of standards that are available and to assess their relevance for ICT product groups citing examples of interrelated relevance throughout the text of the Recommendation. As such, this Recommendation precedes potential product specific standardization of specific ICT product groups and intends to help guide such standardization.

**ITU-T L.1032 "Guidelines and certification schemes for e-waste recyclers"** is part of a series of Recommendations that considers requirements for recyclers of waste information and communication technology (ICT). It addresses in particular the informal sector that is involved in waste electrical and electronic equipment (WEEE) collection and dismantling.

The Recommendations must be read in conjunction with national legislation and technical requirements for WEEE recyclers at the national level. A number of standards on WEEE, related to the present series of Recommendations are published on the website of the ITU-T at <https://itu.int/en/ITU-T>.

Updates on the regional and international conventions and legislation presented can be found at: www.Basel.int (for the Basel Convention), also at: [http://ec.europa.eu/environment/waste/‌shipments/legis.htm](http://ec.europa.eu/environment/waste/shipments/legis.htm) (for the EU waste shipment regulations), and at: [http://ec.europa.eu/‌environment/waste/weee/index\_en.htm](http://ec.europa.eu/%E2%80%8Cenvironment/waste/weee/index_en.htm) (for the EU WEEE directive).

In addition, there are a number of mandatory and voluntary standards on the treatment conditions for workers and the environment that can be used as guidelines to improve national legislation and the quality of recycling where such standards are yet to be implemented.

**ITU-T L.1362 "Interface for power management in network function virtualization environments –Green abstraction layer version 2"** specifies a data model for energy discrete states within virtualized networks, and operations to interact on this model. In virtualized networks, establishing a mapping between the energy discrete states of logical entities (e.g. virtualized network functions) and the energy consumption of the hardware hosting the virtual machines that execute these logical entities is a challenging task. Recommendation ITU-T L.1362 adapts the green abstraction layer specification (GALv1) to virtualized networks.

**ITU-T L.1507 "Use of ICT sites to support environmental sensing"** presents a set of rules for installing the environmental sensing system on ICT sites in order to utilize the ICT sites as environmental sensing stations.

I.6.2 Electromagnetic fields

**ITU-T K.20 (revised) "Resistibility of telecommunication equipment installed in a telecommunication centre to overvoltages and overcurrents"** specifies resistibility requirements and test procedures for telecommunication equipment that is attached to or installed within a telecommunication centre. Overvoltages and overcurrents covered by this Recommendation include surges due to lightning on or near the line plant, short term induction from adjacent a.c. 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 7.10 a twisted pair port transverse/differential test.

**ITU-T K.21 (revised) "Resistibility of telecommunication equipment installed in customer premises to overvoltages and overcurrents"** specifies resistibility requirements and test procedures for telecommunication equipment that is attached to or installed within a customer's premises. Overvoltages or overcurrents covered by this Recommendation include surges due to lightning on or near the line plant, short-term induction from adjacent alternating current (a.c.) 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 are mainly inductive coupling caused by lightning currents being conducted in nearby lightning strikes or lightning currents being conducted by nearby conductors.

Changes compared with Recommendation ITU-T K.21 (2018) include:

• added Special resistibility requirements

• added DC insulation resistance test;

• added test 7.10

• changed some test labels.

**ITU-T K.44 (revised) "Resistibility tests for telecommunication equipment exposed to overvoltages and overcurrents – Basic Recommendation"** (under approval) seeks to establish fundamental test methods and criteria for the resistibility of telecommunication equipment to overvoltages and overcurrents.

Overvoltages or overcurrents covered by this Recommendation include surges due to lightning on or near the line plant, short-term induction of alternating voltages from adjacent electric power lines or electrified railway systems, earth potential rise due to power faults and direct contacts between telecommunication lines and power lines.

Major changes compared with the 2018 version of this Recommendation include:

– Appendices I and II removed and made into K.44 Supplements ;

– New twisted pair transverse/differential surge test circuit ;

– added Ethernet insulation resistance test to avoid port power cross test;

– revision of the test schematics to improve clarity.

**ITU-T K.45 (revised) "Resistibility of telecommunication equipment installed in the access and trunk networks to overvoltages and overcurrents"** (under approval) specifies resistibility requirements and test procedures for telecommunication equipment installed between telecommunication centres and between a telecommunication centre and the customer's premises. Overvoltages or overcurrents covered by this Recommendation include surges due to lightning on or near the line plant, short-term induction from adjacent AC power lines or railway systems, earth potential rise due to power faults, direct contact between telecommunication lines and power lines and electrostatic discharges.

Changes compared with Recommendation ITU-T K.45 (2018) include:

• DC insulation resistance test;

• Special requirements Annex.

**ITU-T K.77 (revised) "Characteristics of metal oxide varistors for the protection of telecommunication installations"** gives the basic requirements to be met by metal oxide varistors (MOVs) for the protection of power circuits and signal circuits of telecommunication installations from surges. The purpose of this Recommendation is to provide technical guidelines for purchasers and manufacturers of MOVs to ensure their satisfactory operation in the applications for which they are intended. This Recommendation is intended to be used for the harmonization of existing or future specifications issued by MOV manufactures, telecommunication equipment manufactures, administrations or network operators.

**ITU-T K.90 Appendix II "Evaluation techniques and working procedures for compliance with exposure limits of network operator personnel to power-frequency electromagnetic fields. Description of the program EMFACDC"**. The software "EMFACDC" in Appendix II of Recommendation ITU-T K.90 was developed in 2012. As the software environment is under constantly development, there was a requirement for software adjustments. These updates were done in the new version v 2.0 that is attached to this document with the following most important modifications:

* procedures "open" and "save" were improved;
* the possibility to save numerical data with results of calculations on the horizontal and vertical lines in \*.csv format was added;
* the new example of the high voltage line with two circuits "delta" type was added
* the main screen was reorganised.

**ITU-T K.91 Appendix IX "Manhole type base station"** presents the measurement results of radio frequency exposure from manhole-type base stations installed underground using the measurement methods introduced in this guideline, in order to evaluate the exposure from these base stations.

**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"** provides information on measurement techniques and procedures for assessing compliance with the general public electromagnetic fields (EMFs) 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 surrounding.

**ITU-T K.112 (revised) "Lightning protection, earthing and bonding: Practical procedures for radio base stations"** 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.116 (revised) "Electromagnetic compatibility requirements and test methods for radio telecommunication terminal equipment"** establishes the essential electromagnetic compatibility (EMC) requirements for radio telecommunication terminal equipment and ancillary accessories. This Recommendation specifies the emission and immunity requirements for radio telecommunication terminal equipment and ancillary equipment including 5G terminal equipment. It also describes test conditions for emission and immunity testing. Performance assessment and criteria for immunity tests are also specified.

**ITU-T K.123 (revised) "Electromagnetic compatibility requirements for electrical equipment in telecommunication facilities"** describes the requirements for radiated and conducted emissions from electrical systems installed in telecommunication facilities. Electrical systems in the scope of this Recommendation include rectifiers that supply direct current (DC) voltages of up to 400 V, power conditioning systems (PCSs) including grid connected power converters (GCPCs), uninterruptible power supplies (UPSs) and inverter driven electrical equipment including the air conditioners needed for the operation of telecommunication systems. Their electrical systems include power conversion devices and may generate conducted and radiated electromagnetic disturbances and cause degradation of the performance of telecommunication systems.

**ITU-T K.140 "Surge protective component application guide – Fuses"** considers fuse and fusible component types, the electrical stress levels pre- and post-operation and gives circuit examples.

**ITU-T K.141 "Electromagnetic compatibility requirements for Information Perception Equipment"** gives the general EMC requirements for information perception equipment used in perception layer on the basis of internet of things (IoT), combined with wireless and wired access, broadband and narrowband application, as well as various intelligent applications.

**ITU-T K.Suppl.9 (revised) "5G technology and human exposure to RF EMF"** contains an analysis of the impact of the implementation of 5G mobile systems with respect to the exposure level of electromagnetic fields (EMF) around radiocommunication infrastructure.

**ITU-T K.Suppl.16 (revised) "Electromagnetic field compliance assessments for 5G wireless networks"** provides guidance on the radio frequency-electromagnetic field (RF-EMF) compliance assessment considerations for IMT-2020 wireless networks also known as 5G. Given that the 5G technical standards have just been finalised and commercial 5G networks are not due to be launched before 2019-2020, the first version of this Supplement is to mainly address the computational assessment options and the assessments of trial networks.

**ITU-T K.Suppl.17 to ITU-T K.44 "Test conditions and methods information"** provides background information that explains how the various lightning and power faults test configurations and electrical values in Recommendation ITU-T K.44 were derived. Examples show how test procedures can be minimised by knowing how the surge and power fault test conditions can vary with time and voltage. How ITU-T Recommendation K.44 relates to its dependent Recommendations is explained.

**ITU-T K.Suppl.18 to ITU-T K.44 "Causes of telecommunication system overvoltage and overcurrent conditions and their expected levels"** discusses how surge and power fault overvoltages and overcurrents are coupled into telecommunication systems, the likely disturbance levels and mitigation measures.

I.6.4 Emergency communication & disaster relief

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

**ITU-T D.198 "Principles for unified format of price/tariffs/rates-lists used for exchanging telephone traffic"** recognizes the right of any operator to present price/tariffs/rates charged for telecommunications services in any form deemed convenient for the operator, and recommends that telecommunications companies offering international connections/exchange of traffic make use as far as possible of the same templates/forms/format of data to represent traffic destinations and offered price/tariffs/rates including if required optional clarifying information or quality of service criteria.

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

**ITU-T D.262 "Collaborative Framework for OTTs"** provides a collaborative framework in order to promote competition, consumer protection, consumer benefits, dynamic innovation, sustainable investment and infrastructure development, accessibility and affordability in relation to the global growth of the Over the Top (OTT) applications.

**ITU-T D.263 "Costs, Charges and Competition for Mobile Financial Services (MFS)"** proposes a possible approach to reduce high retail and wholesale telecommunication charges related to mobile financial service (MFS).

**ITU-T D.264 "Shared use of spectrum and telecommunication infrastructure as possible methods for enhancing the efficiency of telecommunications"** (under approval) proposes a set of possible methods to help telecommunication providers save costs and enhance efficiency through the shared use of spectrum and telecommunication infrastructure, including passive infrastructure sharing, active infrastructure sharing and spectrum sharing in the active infrastructure sharing.

**Technical Report DSTR-DFSECO "Digital Financial Services – The Digital Financial Services Ecosystem"** defines the Digital Financial Services ecosystem and describes the players and their roles within the Ecosystem. These players include users (consumers, businesses, government agencies and non-profit groups) who have needs for digital and interoperable financial products and services; providers (banks, other licensed financial institutions, and non-banks) who supply those products and services through digital means; the financial, technical, and other infrastructures that make them possible; and the governmental policies, laws and regulations which enable them to be delivered in an accessible, affordable, and safe manner. The Technical Report recognizes a goal of reaching "digital liquidity" – a state wherein consumers and businesses are content to leave their funds in digital form, therefore reducing the burden of the "cash-in", "cash-out" process. Various high-level challenges and issues in the ecosystem are acknowledged in this Technical Report: many of these are the subject of more detailed reports produced by the Focus Group. Finally, this Technical Report looks at the many products and services that comprise the DFS ecosystem.

**Technical Report DSTR-DFSREG "Digital Financial Services – Regulation in the Digital Financial Services Ecosystem"** outlines the categories of regulation, defines the corresponding sub-issues or topics and highlights the financial inclusion of each topic. Key categories include

1. agents,
2. consumer protection,
3. market access,
4. payments systems,
5. risk management and
6. other related issues.

This Technical Report also addresses key issues related to managing the regulatory environment. It outlines a survey of how regulators currently work together, provide a draft memorandum of understanding template for Authorities in a given country to formally outline joint goals and methods of working together, and outline considerations if regulators are interested in formalizing cross-border collaborations.

**Technical Report DSTR-DFSSNDL "Impact of social networks on digital liquidity":** Social networks enable users to chat, share photos, and perform similar social activities. As social networks mature, they continually add commercial services such as person-to-person (P2P) payments, shopping at physical stores, and 'conversational commerce' via chat applications.

Social networks have become enormously popular and are themselves bigger than the largest e-commerce companies in the world. Importantly, social networks have determined multiple ways to monetize their user base, including advertising, digital content, and transaction fees. Revenue growth has been impressive: for example, Facebook's revenue has grown from $2 billion to $18 billion in just five years.

At this point in time, however, this social networking and commercial revolution has largely skipped the bottom of the pyramid (BoP). In general, while social networks are present in most developing countries and view the BoP as a big opportunity, the poor are not participating – primarily due to low Internet adoption. But, increasing Internet adoption will not open the social networking floodgate. Feature phones, the primary device used by the poor, limit the social network value proposition. While smartphones offer the best user experience, they introduce new problems such as a short battery life and higher data costs. Even if social network adoption grows, the commercial aspects won't materialize for the poor without financial inclusion – a consumer can't buy unless they link a payment account like M-Pesa to their social network account.

Is this one more example of the digital and financial divide, or can social networks help the BoP economically?

Interestingly, social networks could help close the digital divide by providing various mechanisms, to the extent that they are allowed by regulators:

* Digital on-ramps – Providing a simple, low-cost way of gathering information and communicating with others. For example, chat and VoIP services could reduce spending on SMS and mobile phone calls.
* Platforms for BoP ecosystems – Enabling consumers and entities to create and manage groups, commercially oriented, or otherwise. For example, social network platforms could be used to organize agricultural value chains and enhance how farmers interact with produce buyers, agro-dealers, banks, and other stakeholders. Alternatively, smallholdingfarmers could organize themselves into groups to share knowledge, borrow from banks, or negotiate better prices from crop buyers. Other examples include non-governmental organization (NGO) group lending programs and parent/school groups.
* Payment networks – Providing a global, interoperable, multi-channel and user-friendly eMoney payment network. For example, social networks could resolve mobile network operator (MNO) interoperability issues by integrating with multiple MNO wallets and transferring money between users. Additionally, social networks could provide physical merchants with low cost payment solutions without chip terminal or barcode reader investments.
* Marketplaces – Helping consumers shop better, merchants sell more, and entrepreneurs find more work. This could take the form of selling products to a larger audience, maintaining an ongoing dialogue with existing customers, promoting job skills, discovering employment opportunities, participating in 'on-demand' labour marketplaces, or even virtual entrepreneurship (e.g., YouTube celebrity/entrepreneurs).
* Beneficial data collection – Improving access to credit and enabling targeted outreach and advertising. For example, transaction histories and merchant reputation ratings could provide BoP merchants with greater access to credit. Additionally, richer consumer data could allow NGOs and governments to target interventions on a large level, or on a very small level by simply allowing an individual to sell their bicycle within the local community.

That said, policy makers face a tough balancing act. On one hand, social networks can bring significant value to BoP populations and policy makers should therefore consider policies that encourage adoption. On the other hand, social networks are tremendously powerful and regulators should explore policies that protect consumers from potentially harmful effects, paying special attention to data privacy, market power, and other concerns.

In short, social networks have tremendous potential to enable new forms of commerce, benefitting BoP buyers and sellers and helping eMoney systems move towards digital liquidity, but a comprehensive, long-range perspective will be important for optimizing the value for all stakeholders.

**Technical Report DSTR-DFSCA "Competition Aspects of Digital Financial Services"** enumerates a sampling of competition issues stemming primarily from access to, and the use of technology in, the digital financial services (DFS) ecosystem from the perspective of its stakeholders. The Technical Report outlines competition issues that have been identified by the author based on publicly available and ventilated examples and studies of DFS ecosystems worldwide, as of January 2017. Insights from market participants, analysts, and regulators participating in the ITU Focus Group on DFS and externally are also included.

Country examples are from: Bangladesh, China, Colombia, Georgia, Ghana, India, Jordan, Kenya, Malawi, Mexico, Nepal, Nigeria, Pakistan, Peru, Philippines, South Africa, Sri Lanka, Tanzania, Uganda, Zambia, and Zimbabwe. In some instances, multiple competition-related issues in the DFS ecosystem in a country may manifest. As a pure information resource for the DFS Focus Group, this study does not make any conclusions or recommendations as to how the issues described may be approached or resolved.

Technical Report DSTR-DFSRP "The Regulator's Perspective on the Right Timing for Inducing Interoperability - Findings of a survey among Focus Group Members": Interoperability has been understood as a relevant aspect in fostering the financial inclusion efforts made through the availability of digital financial services (DFS). Despite the fact that some consensus has been achieved and the regulator can now have an important role in inducing interoperability, the right timing for and scope of the regulator's actions is still an open discussion. This Technical Report provides insights shared by five regulators who participated in the DFS Focus Group WG on Interoperability. Although it is impossible to generalize conclusions from the survey, some similarities across the surveyed countries can be observed.

First, before addressing DFS interoperability, the financial and telco regulators need to define their roles and responsibilities among each other. Second, although regulators generally seem to consider interoperability an important element in the DFS ecosystem, the current state of interoperability in different countries varies substantially. Third, positive outcomes are reported—or at least expected—across countries, suggesting that current policies might persist for the time being. Fourth, authorities seem to be conscious of the fact that any intervention needs to be considered carefully and take place only when no market-driven solution is leading to interoperable services.

Technical Report DSTR-DFSPI "Digital Financial Services – Access to Payment Infrastructures": Non-banks are having an increasing role in payments, including the provision of payments services directly to end-users. Despite this increasing role, many of them are still not accepted as direct participants of key payment infrastructures, which often leads to limited or null interoperability in the services/products they offer. Moreover, being able to use key payment infrastructures at a reasonable cost and with appropriate service levels is an important element underlying a competitive payments market.

The operators of these payment infrastructures should adhere to international standards and best practice and establish risk-based and objective access criteria, and ensure that any PSP that wishes to gain direct access and meets such criteria is able to join as a direct participant.

Still, for many non-bank PSPs gaining direct access may not be feasible due to the investments they would need to make in order to fulfill the infrastructure's access criteria. In such cases indirect access mechanisms may be capable of providing these PSPs with suitable payment services. However, in certain cases indirect access may not be as effective, for example if charges applied by the principal (an entity that is a direct participant in the infrastructure) are excessive relative to the costs it itself incurs for using the system, or if the criteria set by the principal for opening accounts and providing payment services to customer PSPs are disproportionate.

Payment system regulators, in particular the central bank as the payment system overseer, should ensure that all PSPs are able to gain fair access to payment services, including those for which direct access is not financially feasible and need to access the services through a principal.

Effective access to payment infrastructures may also be hampered if there are barriers to accessing the telecommunications networks serving those infrastructures. Telecomm regulators may also have a role to play in markets where it has been observed that MNOs that are involved in the payments business restrict in some form the access to other PSPs to the mobile telecommunications network that these MNOs operate.

Technical Report DSTR-DFSUAAFR "Digital financial services – Review of DFS User Agreements in Africa: A Consumer Protection Perspective" explains the findings from an analysis of DFS user agreements in nine African countries and attempts to understand the overall consumer experience and whether or not there is a disconnect between contract provisions and the legal and regulatory provisions governing DFS. It highlights key findings, and makes a number of recommendations for action by the appropriate regulator in the various markets examined. Countries need to take these considerations into account as they continue to nurture their DFS markets so as to safeguard customers from harmful practices and ensure trust in the market.

Technical Report DSTR-DFSCP "Digital Financial Services – Commonly identified Consumer Protection themes for Digital Financial Services" is a synthesis of existing research, legal provisions, guidelines, and other related resources related to consumer protection for digital financial services. This Technical Report identifies four common themes that policy makers or regulators may want to consider when developing laws, regulations, or guidelines related to DFS.

This list is not exhaustive, but rather indicative of the types of issues that can be considered. In addition, consumer protection for digital financial service is a new area for regulations, and in many cases there is continued discussion and debate about which aspects can be best addressed by industry-led actions, versus requiring regulations. Finally, the feasibility of implementation and enforcement have not been taken into account when developing this list; these of course are critical elements when developing actual DFS guidelines.

The four themes are:

1. Provision of information and transparency
2. Fraud prevention
3. Dispute resolution
4. Data privacy and protection

For each theme a set of key issues have been identified, which are discussed in the following sections.

**Technical Report DSTR-DFSMR "Digital Financial Services – Main recommendations"** outlines the main recommendations of the ITU Focus Group on Digital Financial Service (FG-DFS) and identifies key areas where intervention by regulators, DFS operators and policymakers are needed to create a conducive environment for digital financial services. The recommendations are grouped under the following main headings of each working group:

* Ecosystem
* Interoperability
* Technology, Innovation and Competition (TIC)
* Consumer Experience and Protection (CEP).

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

**ITU-T E.805 "Strategies to establish quality regulatory frameworks"** (under approval) provides guidance to regulators aiming to establish national or regional regulatory frameworks to monitor and measure quality of service (QoS) and quality of experience (QoE).

**ITU-T E.806 "Measurement campaigns, monitoring systems and sampling methodologies to monitor the QoS in mobile networks"** describes a baseline framework of best practices for measuring QoS in mobile networks. It provides a high-level overview of measurement campaigns, monitoring systems characteristics and requirements, post-processing general recommendations and sampling methodologies to monitor mobile electronic services. This Recommendation is technology-neutral but may state different requirements depending on the services being measured.

**ITU-T G.107.1 (revised) "Wideband E-model"** gives the algorithm for the wideband (WB) version of the E-model as the common ITU-T transmission rating model for planning speech services that provide WB speech transmission (50-7000 Hz). This computational model can be useful to transmission planners, to help ensure that users will be satisfied with end-to-end transmission performance. The primary output of the model is a scalar rating of transmission quality. A major feature of this model is the use of transmission impairment factors that reflect the effects of different types of degradations occurring on the entire transmission path, mouth-to-ear.

This WB-E-model is an adapted version of the narrowband (NB) (300-3400 Hz) E-model, typically referred to as "the E-model", which is described in Recommendation ITU-T G.107. It does not replace the NB E-model. Instead, it describes a separate WB version of the model that uses, within limits, similar concepts and input parameters as the NB E-model.

**ITU-T G.107.2 (revised) "Fullband E-model"** gives the algorithm for the fullband (FB) version of the E-model as the common ITU-T transmission rating model for planning speech services that provide FB speech transmission (20-20000 Hz). This computational model can be useful to transmission planners, to help ensure that users will be satisfied with end-to-end transmission performance. The primary output of the model is a scalar rating of transmission quality. A major feature of this model is the use of transmission impairment factors that reflect the effects of different types of degradations occurring on the entire transmission path, mouth-to-ear.

This FB-E-model is an adapted version of the narrowband (NB) (300-3400 Hz) and wideband (WB) (50-7000 Hz) E-models, which are described in Recommendations ITU-T G.107 (NB) and ITU-T Rec. G.107.1 (WB). It does not replace the NB or the WB E-model. Instead, it describes a separate FB version of the model that uses, within limits, similar concepts and input parameters as the NB and WB E-models.

**ITU-T G.113 Amd.2 "New Appendix V – Provisional planning values for the fullband equipment impairment factor and the fullband packet loss robustness factor"** provides up-to-date information on available values of fullband equipment impairment factors, Ie,fb, and packet loss robustness factors, Bpl, fb. It is intended to be updated regularly. These values are to be used on an extended transmission rating scale (R-scale) as it is defined in [ITU-T Rec. G.107.2].

I.9 Conformity, interoperability and testing

I.9.3 SIP-IMS conformity assessment and interconnection testing

**ITU-T Q.4014.1 "PSTN/ISDN terminal equipment using IP Multimedia core network subsystem; Conformance testing; Part 1: PICS"** is a part 1 of the testing specifications of the terminal equipment used in the IMS-based PSTN/ISDN Emulation subsystem based on the media gateway control protocol, the session initiation protocol and the associated session description protocol. The Recommendation specifies the Protocol Implementation Conformance Statement to test PSTN/ISDN terminal equipment using IP Multimedia core network subsystem.

**ITU-T Q.4014.2 "PSTN/ISDN terminal equipment using IP Multimedia core network subsystem; Conformance testing; Part 2: TSS&TP"** is a part 2 of the testing specifications of the terminal equipment used in the IMS-based PSTN/ISDN Emulation subsystem based on the media gateway control protocol, the session initiation protocol and the associated session description protocol. The Recommendation specifies the Test Suite Structure and Test purposes to test PSTN/ISDN terminal equipment using IP Multimedia core network subsystem.

I.9.8 Testing Internet of things

I.9.9 Testing energy efficiency of base stations

I.9.10 Testing cloud computing

**ITU-T Q.4042.1 "Cloud interoperability testing about web application – part 1: Interoperability testing between CSC and CSP"** specifies the cloud interoperability testing items about web application between CSC and CSP as part 1. These testing objects are developed on the basis of cloud computing interoperability testing objectives specified in [ITU-T Q.4040]. The test cases for cloud interoperability testing about web application have also been introduced as appendix.

**ITU-T Q.4043 "Interoperability testing requirements of virtual switch"** specify virtual switch (vswitch) interoperability testing requirements. Firstly, as a basic background, this Recommendation introduces the overview of vswitch and interoperability testing of vswitch, which includes but not limited to the definition, characterises, general capabilities of vswitch as well as the overview of interoperability testing of vswitch. The description of cloud related use cases of vswitch is provided in the appendix, which will describe the involved interaction process. Based on analysis of involved vswitch capabilities in cloud related use cases, the corresponding derived requirements of vswitch's interoperability testing are introduced.

I.9.11 Testing SDN

**ITU-T Q.4061 "Framework of SDN controller testing"**: The concept of IMT-2020 is represented by a set of wide spectrum of info-communication applications, cloud services and network infrastructure, dynamically responding to the relevant requirements of each service, as already widely used and new. One of the approaches to build network infrastructure is software-defined approach (SDN). It is described in ONF TR-526 (consortium of the Open Network Foundation), and in ITU-R M.2083. This document contains: classification of SDN controller's tests; parameters, structure, sequence and methodology of SDN controller testing; testing report containment.

I.10 Mainstreaming accessibility in ICTs

**ITU-T Y.4204 "Accessibility requirements for the Internet of things applications and services"** provides accessibility requirements specific to Internet of Things (IoT) applications and services. Benefits of accessible IoT applications and services are addressed, and accessibility requirements for IoT applications and services for persons with disabilities, persons with age related disabilities and those with specific needs to utilize the benefits of IoT applications and services, are specified. Some use cases are also provided in the Appendix to illustrate the need for IoT accessibility. This Recommendation complements existing Recommendations specifically defined for certain platforms in case such platforms are applied in the IoT context.

See also ITU-T H.871 "Safe listening guidelines for personal sound amplifiers" in section I.4.5, [above](#H871).

I.11 Combating Counterfeiting

**ITU-T Q.5050 "Framework for solution to combat counterfeit ICT devices":** There has been growing usage of ICT equipment in people's daily lives, in recent years, but there have also been unwelcome side effects related to the increased in the sale, circulation and use of counterfeit ICT devices in the market.

Counterfeit ICT device is a product that explicitly infringes the trademark, copies hardware or software designs, or infringes brand or packaging rights of an original or authentic product and, in general, infringes applicable national and/or international technical standards, regulatory requirements or conformity processes, manufacturing licensing agreements, or other applicable legal requirements.

Among the various types of ICT devices used today, smartphones and other mobile devices have become pervasive and desirable items amongst the world population, and, as a side effect, have also raised the attention of the global black/grey market.

This results in adverse consequences for stakeholders such as users, network operators, genuine device manufacturers, traders and governments, including decreased security protection and quality of service for users and revenue losses to a range of stakeholders.

Since the supply and demand economics for counterfeit ICT devices complicate attempts to tackle the global counterfeit market, no single solution can solve the problem alone, requiring that a broad range of measures to be taken in a holistic approach.

Therefore, this Recommendation aims to describe a reference framework, with high level challenges and requirements, that should be considered when deploying solutions to combat the circulation and use of counterfeit ICT devices.

I.12 Signalling Protocols

**ITU-T Q.731.3 (revised) "Stage 3 Description for number identification supplementary services using Signalling System no.7 - Calling Line Identification Presentation"** provides signalling procedure for calling line identification presentation (CLIP). It specifies service description, operation requirements and coding requirements of CLIP. It also presents the signalling requirements for originating local exchange, transit exchange, international gateway exchange and destination local exchange. Interaction with other supplement services, interaction with other network and dynamic description are included as well.

**ITU-T Q.731.4 (revised) "Stage 3 Description for number identification supplementary services using Signalling System no.7 - Calling Line Identification Restriction"** provides signalling procedure for calling line identification restriction (CLIR). It specifies service description, coding requirements and operation requirements of CLIR. It also presents the signalling requirements for originating local exchange, transit exchange, international gateway exchange and destination local exchange. Interaction with other supplement services, interaction with other network and dynamic description are included as well.

**ITU-T Q.731.5 (revised) "Stage 3 Description for number identification supplementary services using Signalling System no.7 - Connected Line Identification Presentation"** provides signalling procedure for connected line identification presentation (COLP). It specifies service description, coding requirements and operation requirements of COLP. It also presents the signalling requirements for originating local exchange, transit exchange, international gateway exchange and destination local exchange. Interaction with other supplement services, interaction with other network and dynamic description are included as well.

**ITU-T Q.731.6 (revised) "Stage 3 Description for number identification supplementary services using Signalling System no.7 - Connected Line Identification Restriction"** provides signalling procedure for connected line identification restriction (COLR). It specifies service description, coding requirements and operation requirements of COLR. It also presents the signalling requirements for originating local exchange, transit exchange, international gateway exchange and destination local exchange. Interaction with other supplement services, interaction with other network and dynamic description are included as well.

**ITU-T Q.850 (2018) Amd.1 (revised) "Usage of cause and location in the Digital Subscriber Signalling System No. 1 and the Signalling System No. 7 ISDN user part"** incorporates all points highlighted in ITU-T Q.850 Amd.1 and ITU-T Q.850 Add.1.

**ITU-T Q.3054 "Signalling architecture for virtualization of control network entities"** provides functional architecture for virtualization of control network entities. Based on the functional architecture of virtualization of control network entities, it specifies the signalling requirements for interfaces supporting the reference points in architecture for virtualization of control network entities. It defines the protocols used for interfaces and provides security considerations as well.

**ITU-T Q.3741 "Signalling Requirements for SD-WAN service"** specifies signalling requirements for SD-WAN service launched by service providers. The signalling is to support the automated provision and management of the enterprise SD-WAN service.

I.13 Formal Languages and Identification

**ITU-T E.217 (revised) "Maritime communications - Ship station identity"**: For the purposes of International Public Correspondence Telecommunication, the ship station identity is now only relevant for those existing systems that have the ship station identity embedded in the numbering scheme as illustrated in Annexes A and B. For future systems that will not embed the ship station identity in their numbering scheme the ship station identity ceases to have any relevance for public correspondence telecommunication purposes. This revision of E.217 includes relevant text from E.210 as it combines both of those Recommendations into E.217. In addition it reflects changes that have occurred within the existing family of services provided by Inmarsat that impact the provision of Global Maritime Distress and Safety System (GMDSS). For historical accuracy this revised version also reflects details of the provision of Inmarsat services prior to the expansion of the E.164 numbering plan (ITU-T Recommendation E.164 'The international public telecommunication numbering plan') from a maximum of 12 to 15 digits.

**ITU-T Z.100 Annex F1 (revised) "Specification and Description Language - Overview of SDL-2010 - Annex F1: SDL-2010 formal definition: General overview"** provides the motivation for and the main objectives of a formal semantics definition for SDL-2010. It gives an overview of the structure of the formal semantics, and it also contains an introduction to the Abstract State Machine (ASM) formalism, which is used to define the SDL‑2010 semantics.

**ITU-T Z.100 Annex F2 (revised) "Specification and Description Language – Overview of SDL 2010 - Annex F2: SDL 2010 formal definition: Static semantics"** 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 - Annex F3: SDL 2010 formal definition: Dynamic semantics"** defines the SDL 2010 dynamic semantics.

**ITU-T Z.151 (revised) "User Requirements Notation (URN) - Language definition"** defines the User Requirements Notation (URN) intended for the elicitation, analysis, specification and validation of requirements. URN combines modelling concepts and notations for goals (mainly for non-functional requirements and quality attributes) and scenarios (mainly for operational requirements, functional requirements and performance and architectural reasoning). The goal sub-notation is called Goal-oriented Requirements Language (GRL) and the scenario sub‑notation is called Use Case Map (UCM).

**ITU-T Z.161 (revised) "Testing and Test Control Notation version 3: TTCN-3 core language"** defines TTCN-3 (Testing and Test Control Notation 3) 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.

**ITU-T Z.161.2 (revised) "Testing and Test Control Notation version 3: TTCN-3 language extensions: Configuration and deployment support"** defines the configuration and deployment support package of TTCN-3.

**ITU-T Z.161.4 (revised) Testing and Test Control Notation version 3: TTCN-3 language extensions: Behaviour types"** defines the behaviour types package of TTCN‑3.

**ITU-T Z.161.6 (revised) "Testing and Test Control Notation version 3: TTCN-3 language extensions: Advanced matching"** defines the support of advance matching 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 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. TTCN-3 packages are intended to define additional TTCN-3 concepts, which are not mandatory as concepts in the TTCN-3 core language, but which are optional as part of a package which is suited for dedicated applications and/or usages of TTCN-3. While the design of TTCN-3 package has taken into account the consistency of a combined usage of the core language with a number of packages, the concrete usages of and guidelines for this package in combination with other packages is outside the scope of the present document.

**ITU-T Z.166 (revised) "Testing and Test Control Notation version 3: TTCN-3 control interface (TCI)"** specifies the control interfaces for TTCN-3 test system implementations, and provides a standardized adaptation for management, test component handling and encoding/decoding of a test system to a particular test platform.

**ITU-T Z.167 (revised) "Testing and Test Control Notation version 3: Using ASN.1 with TTCN-3"** 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.

**ITU-T Z.169 (revised) "Testing and Test Control Notation version 3: Using XML schema with TTCN-3"** defines the mapping rules for W3C Schema to TTCN-3 to enable testing of XML-based systems, interfaces and protocols.

**ITU-T Z.171 (revised) "Testing and Test Control Notation version 3: Using JSON with TTCN-3"** 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.

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