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| A black and white logo  Description automatically generated with low confidence | INTERNATIONAL TELECOMMUNICATION UNION  **TELECOMMUNICATION STANDARDIZATION SECTOR**  STUDY PERIOD 2022-2024 | | | TSAG-TD189 |
| **TSAG** |
| **Original: English** |
| **Question(s):** | | | N/A | Geneva, 30 May - 2 June 2023 |
| **TD** | | | | |
| **Source:** | | | Director, TSB | |
| **Title:** | | | Report of activities in ITU-T (from 1 December 2022 to 19 May 2023) | |
| **Contact:** | | TSB | | E-mail: [tsbtsag@itu.int](mailto:tsbtsag@itu.int) |

|  |  |
| --- | --- |
| **Abstract:** | This report summarizes TSB facilitation of ITU-T activities from 1 December 2022 to 19 May 2023. |

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# Executive Summary

ITU approved 178 new and revised ITU-T Recommendations and related texts from December 2022 to May 2023. The appendix to this report lists these texts as well as texts undergoing approval and summarizes their contents. Executive summaries of ITU-T study group meetings can be found on their respective [homepages](https://www.itu.int/en/ITU-T/studygroups/Pages/default.aspx). See [section 1](#_1_ITU-T_Study).

Seven ITU-T focus groups are active. New focus groups on [metaverse](https://www.itu.int/en/ITU-T/focusgroups/mv/Pages/default.aspx) and [cost models for affordable data services](https://www.itu.int/en/ITU-T/focusgroups/cd/Pages/default.aspx) were established in December 2022 and March 2023, respectively. The focus group on [environmental efficiency for AI and other emerging technologies](https://www.itu.int/en/ITU-T/focusgroups/ai4ee/Pages/default.aspx) concluded activities in December 2022. Information on the activities and deliverables of ITU-T focus groups can be found on their respective [homepages](https://www.itu.int/en/ITU-T/focusgroups/Pages/default.aspx) and an index of these groups and their timeframes is provided in [section 2](#_2_ITU-T_Focus).

29 ITU-T [workshops and symposia](https://www.itu.int/en/ITU-T/Workshops-and-Seminars/Pages/default.aspx) were organized in the reporting period, in addition to the near-daily programming of the year-round [AI for Good](https://aiforgood.itu.int/) digital platform. See [section 3](#_3_Workshops_and). TSB has facilitated 1,643 e-meetings in 2023, welcoming 25,734 attendees. See [section 4](#_4_Virtual_meetings).

ITU-T currently hosts 268 Sector Members and 223 Associates. ITU Academia members now total 172. 56 of ITU-T's Associates are now participating under the reduced fee structure for small and medium-sized enterprises which came into effect on 31 January 2020. See [section 11](#_11_Membership).

The upcoming [AI for Good Global Summit](https://aiforgood.itu.int/) in Geneva, 6-7 July 2023, will feature world-renowned experts in AI and humanitarian action and the world's largest-ever gathering of humanoid and specialized robots. It will be preceded by expert-oriented machine learning workshops, 4-5 July, drawing on expertise from the AI for Good Discovery programme. Over 17,000 people have created profiles on the [AI for Good Neural Network](https://aiforgood.itu.int/neural-network/) since its launch in February 2022. [The fourth edition of the ITU AI/ML in 5G Challenge](https://aiforgood.itu.int/about-ai-for-good/aiml-in-5g-challenge/) is underway. More than half of the Challenge participants in 2022 were students, with a large majority not yet ITU members See [section 5.1](#_5.1_Artificial_intelligence).

The second edition of the [DC3 Conference: From Cryptocurrencies to Central Bank Digital Currencies](https://www.itu.int/en/ITU-T/Workshops-and-Seminars/2023/0124/Pages/default.aspx) was held online, 24-27 January 2023. [ITU Security Clinics for Digital Financial Services (DFS)](https://figi.itu.int/itu-dfs-security-clinics/) offer guidance to regulators and DFS providers on adopting the security best practices developed under the [Financial Inclusion Global Initiative (FIGI)](https://figi.itu.int/). The [ITU DFS Security Lab](https://figi.itu.int/figi-resources/dfs-security-lab/) helps stakeholders to verify that these best practices are being followed. A growing number of countries are adopting the DFS security recommendations developed under FIGI and establishing their own DFS security labs with the support of ITU knowledge-transfer activities. See [section 5.2](#_5.2_Digital_financial).

The [United for Smart Sustainable Cities (U4SSC)](http://www.itu.int/en/ITU-T/ssc/united/Pages/default.aspx) initiative is supported by 19 UN bodies with the aim of achieving the SDG11 ("Make cities and human settlements inclusive, safe, resilient and sustainable"). Over 150 cities have adopted [U4SSC Key Performance Indicators](https://www.itu.int/en/ITU-T/ssc/united/Pages/publication-U4SSC-KPIs.aspx) based on ITU standards. The results of these evaluations are shared by [city snapshots, factsheets, verification reports and case studies](https://www.itu.int/en/ITU-T/ssc/united/Pages/publication-U4SSC-KPIs.aspx). Two [new U4SSC reports](https://u4ssc.itu.int/publications/) provide procurement guidelines for smart sustainable cities and a compendium of practices on innovative financing for smart sustainable cities projects. See [section 5.3](#_5.3_Smart_cities).

The [ITU-UNECE Future Networked Car Symposium](https://fnc.itu.int/) was held online, 13-16 March 2023. The annual symposium examines the latest advances in vehicle connectivity, automated mobility, and the role of artificial intelligence in ​the transport sector, sharing unique insight into associated implications for technology, business and regulation. See [section 5.5](#_5.5_Intelligent_transport).

A [CxO Meeting](https://www.itu.int/en/ITU-T/tsbdir/CxO/Pages/CxO-20221206.aspx) was held on 6 December 2022 at the Telecom Review Leader's Summit in Dubai, United Arab Emirates, with additional participation online. CxOs discussed industry priorities in the areas of AI and machine learning, environmental sustainability, sustainability reporting, the metaverse, quantum information technologies, and 5G and beyond. See [section 5.6](#_5.6_CTO_and).

[ITU Academia membership](https://www.itu.int/hub/membership/), the [ITU Journal on Future and Evolving Technologies](https://www.itu.int/en/journal/j-fet/Pages/default.aspx), and [ITU Kaleidoscope conferences](https://www.itu.int/en/ITU-T/academia/kaleidoscope/Pages/default.aspx) form key avenues for academics to engage in ITU’s work. Journal issues published in the reporting period feature research on topics including 6G, network solutions for future services, intelligent surfaces, and the digital continuum. A [special series of journal webinars](https://www.itu.int/en/journal/j-fet/webinars/Pages/default.aspx) beginning on 6 June 2023 will share insights from CTOs on industry ambitions for 5G, 6G, and associated innovations to boost network intelligence. Kaleidoscope 2022 in Accra, Ghana, 7-9 December 2022, explored the innovation required to make the metaverse a reality. See [section 6](#_6_Academia).

[ITU's Bridging the Standardization Gap (BSG) programme](https://www.itu.int/en/ITU-T/gap/Pages/default.aspx) improves the capacity of developing countries to participate in the development and implementation of international ICT standards. Nine BSG training sessions were held in the reporting period. 136 fellowships and e-fellowships were requested from December 2022 to March 2023, with 73 awarded and 60 used. See [section 12](#_12_Bridging_the).

TSB has conducted a survey to collect more insights from ITU-T members on various ways to accelerate the improvement of gender balance ITU-T. The survey's results are currently being compiled. TSB is also inviting ITU-T members and staff involved in standards-development processes to undertake a [training course](https://learnqi.unece.org/courses/gender-responsive-standards/) on gender-responsive standards development. See [section 13](#_13_Gender).

Testing labs can now obtain official recognition from ITU for their competence to test the conformance of products with ITU-T Recommendation. The first 11 testing labs have been listed in the new [ITU Testing Laboratories Database](https://itu.int/go/tldb) for ITU-recognized facilities. For buyers seeking standards-based solutions, the complementary [ITU Product Conformity Database](http://www.itu.int/net/itu-t/cdb/ConformityDB.aspx) lists products compliant with ITU-T Recommendations. The testing lab recognition scheme, supported by the [ITU-T Conformity Assessment Steering Committee](https://www.itu.int/en/ITU-T/studygroups/com11/casc/Pages/default.aspx), is the latest initiative under the [ITU Conformity and Interoperability programme](https://www.itu.int/en/ITU-T/C-I/Pages/default.aspx). See [section 8](#_8_Conformity_and).

Over 8,000 pages of ITU-T Recommendations and Supplements were published in the reporting period. All major editions of ITU-T Recommendations are converted to the reflowable ePub format, and are published for free download alongside the usual PDF format. See [section 14.1](#_14.1_Recommendations_and).

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](https://www.itu.int/br_tsb_terms/#/). TSB continues to translate all Recommendations approved under the Traditional Approval Process as well as all TSAG reports. On request, TSB translated eight Recommendations approved under the Alternative Approval Process in the reporting period. See [section 14.2](#_14.2_Official_languages).

TSB continuously develops new applications using, where applicable, open-source and machine learning solutions, in addition to the ITU infrastructure services, while enhancing existing applications, to expand further its ongoing digital transformation. The "[AI-based mapping of ITU activities to UN-SDGs](https://aisdg.itu.int/)" maps ITU work to the UN Sustainable Development Goals according to semantic relevance. See [section 15](#_15_Services_and).

# Annex – Full report of activities in ITU-T in the study period

# 1 ITU-T Study Groups

ITU approved 178 new and revised ITU-T Recommendations and related texts from December 2022 to May 2023. Annex 1 to this report lists these texts as well as texts undergoing approval and summarizes their contents. For all ITU-T Recommendations in force, see the [catalogue of ITU-T Recommendations](https://www.itu.int/en/ITU-T/publications/Pages/recs.aspx).

Executive summaries of ITU-T study group (SG) meetings can be found on their respective [homepages](https://www.itu.int/en/ITU-T/studygroups/Pages/default.aspx). ITU-T study group meetings held in the reporting period:

* [SG3](https://www.itu.int/go/tsg3): Geneva, 1-10 March 2023
* [SG5](https://www.itu.int/go/tsg5): E-meeting, 5 December 2022
* [SG9](https://www.itu.int/go/tsg9): Bangalore, India, 9-18 May 2023
* [SG11](https://www.itu.int/go/tsg11): Geneva, 10-19 May 2023
* [SG12](https://www.itu.int/go/tsg12): Geneva, 18-26 January 2023
* [SG13](https://www.itu.int/go/tsg13): Geneva, 13-24 March 2023
* [SG15](https://www.itu.int/go/tsg15): Geneva, 17-28 April 2023
* [SG17](https://www.itu.int/go/tsg17): Geneva, 21 February - 3 March 2023
* [SG20](https://www.itu.int/go/tsg20): Geneva, 30 January - 10 February 2023

## 1.2 Non-attendance of chairmen and vice-chairmen

PP Resolution 208 (Rev. Bucharest, 2022) "Appointment and maximum term of office for chairmen and vice-chairmen of Sector advisory groups, study groups and other groups" resolves that a Sector advisory group, study group or other group shall be made aware of the non-attendance of Chairmen and Vice-Chairmen in their respective groups and raise the issue through the Director of the relevant Bureau with the members concerned in an attempt to encourage and facilitate participation in these roles.

The following table lists Vice-Chairmen not in attendance at study group meetings held in the reporting period:

|  |  |  |
| --- | --- | --- |
| **Study Group** | **Non-attendance of** | **Meetings** |
| SG5 | Pedro BRISSON, Argentina | E-meeting, 5 December 2022 |
| Vincent Urbain NAMRONA, Central African Republic |
| Saidiahrol SAIDIAKBAROV, Republic of Uzbekistan |
| Nevine TEWFIK, Egypt |  |
| SG9 | Blaise MAMADOU, Central African Republic | Bangalore, India, 9-18 May 2023 |
| SG11 | Ibrahim Abdalah Mohamed BALA, Sudan | Geneva, 10-19 May 2023 |
|  | Juan Matias CATTANEO, Argentina |  |
|  | Arezu OROJLU, Iran |  |
| SG12 | Ammar ABDALLAH, Sudan | Geneva, 18-26 January 2023 |
| Collins MBULO, Zambia |
| Edoyemi OGOH, Nigeria |
| SG13 | Bülent ARSAL, Turkey | Geneva, 13-24 March 2023 |
| Anabel DEL CARMEN CISNEROS, Argentina |
| SG17 | Francisco Javier DÍAZ, Argentina | Geneva, 21 February - 3 March 2023 |
| Gökhan EVREN, Turkey |

# 2 ITU-T Focus Groups

Below lists the ITU-T focus groups (FGs) of the study period, with section 2.1 listing active groups and section 2.2 listing groups that completed activities. Information on the activities and deliverables of each group can be found on their respective homepages. See also the [ITU-T focus groups homepage](https://www.itu.int/en/ITU-T/focusgroups/Pages/default.aspx).

## 2.1 Active groups

| **ITU-T Focus Group** | **Start date** |
| --- | --- |
| [Cost models for affordable data services (FG-CD)](https://www.itu.int/en/ITU-T/focusgroups/cd/Pages/default.aspx) | 2023-03 |
| [Metaverse (FG-MV)](https://www.itu.int/en/ITU-T/focusgroups/mv/Pages/default.aspx) | 2022-12 |
| [Testbeds Federations for IMT-2020 and Beyond (FG-TBFxG)](https://www.itu.int/en/ITU-T/focusgroups/tbfxg/Pages/default.aspx) | 2021-12 |
| [AI and IoT for Digital Agriculture (FG-AI4A)](https://www.itu.int/en/ITU-T/focusgroups/ai4a/Pages/default.aspx) | 2021-10 |
| [AI for Natural Disaster Management (FG-AI4NDM)](https://www.itu.int/en/ITU-T/focusgroups/ai4ndm/Pages/default.aspx) | 2020-12 |
| [Autonomous Networks (FG-AN)](https://www.itu.int/en/ITU-T/focusgroups/an/Pages/default.aspx) | 2020-12 |
| [AI for Health (FG-AI4H)](https://www.itu.int/en/ITU-T/focusgroups/ai4h/Pages/default.aspx) | 2018-07 |

## 2.2 Concluded groups

|  |  |  |
| --- | --- | --- |
| **ITU-T Focus Group** | **Start date** | **End date** |
| [Environmental Efficiency for AI and other Emerging Technologies (FG-AI4EE)](https://www.itu.int/en/ITU-T/focusgroups/ai4ee/Pages/default.aspx) | 2019-05 | 2022-12 |
| [AI for Autonomous and Assisted Driving (FG-AI4AD)](https://www.itu.int/en/ITU-T/focusgroups/ai4ad/Pages/default.aspx) | 2019-10 | 2022-09 |
| [Vehicular Multimedia (FG-VM)](https://www.itu.int/en/ITU-T/focusgroups/vm/Pages/default.aspx) | 2018-07 | 2022-09 |

# 3 Workshops and symposia

29 ITU-T workshops and symposia were organized in the reporting period, in addition to the weekly programming of the year-round [AI for Good](https://aiforgood.itu.int/) digital platform. A listing of all past and planned events can be found on the [ITU-T events homepage](https://www.itu.int/en/ITU-T/Workshops-and-Seminars/Pages/default.aspx).

ITU-T 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.

# 4 Virtual meetings

MyMeetings is the main platform for ITU-T statutory meetings. MyMeetings is also used to host Rapporteur Group Meetings and non-statutory events, such as webinars. MyMeetings features important elements found in ITU-T physical meetings, including lists of participants and their affiliations, moderated floor requests, and captioning. Several layers of access control ensure that only registered participants gain access to statutory meetings.

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

Statistics on e-meetings since 2018 are shown below.

* 2018: 1,558 e-meetings; 8,353 attendees
* 2019: 2,110 e-meetings; 17,657 attendees
* 2020: 4,220 e-meetings; 77,693 attendees
* 2021: 4,671 e-meetings; 87,302 attendees
* 2022: 5,430 e-meetings; 78,270 attendees
* 2023 (until May): 1,643 e-meetings; 25,734 attendees

Figure 1 – Remote participation and e-meetings

# 5 Collaboration initiatives

## 5.1 Artificial intelligence and machine learning

[AI for Good](https://aiforgood.itu.int/) is the United Nations' primary platform for artificial intelligence (AI). It is the world’s premier platform to advance AI’s contribution to sustainable development. AI for Good is supported by 40 UN partners and a range industry sponsors, and co-convened by the government of Switzerland.

**AI for Good Global Summit 2023:** The upcoming AI for Good Global Summit in Geneva, 6-7 July 2023, will feature world-renowned experts in AI and humanitarian action and the world's largest-ever gathering of humanoid and specialized robots. This fourth summit follows summits held in Geneva in 2017, 2018, and 2019. The upcoming summit will be preceded by expert-oriented ML workshops, 4-5 July, drawing on expertise from the AI for Good Discovery programme.

**All year, always online:** AI for Good is now presented as a year-round digital platform where AI innovators and problem owners learn, build, and connect to help identify practical AI solutions to advance the UN Sustainable Development Goals (SDGs). The [AI for Good Neural Network](https://aiforgood.itu.int/neural-network/) features AI-enabled smart matching to help users build connections, link innovative ideas with social impact opportunities, and discuss AI applications for social good. Over 17,000 people have created profiles on the Neural Network since its launch in February 2022.

**Support to focus group activities:** The majority of the ITU-T focus groups addressing AI and machine learning (ML), as well as the Global Initiative on AI and Data Commons and the AI for Road Safety initiative, were first conceptualized during AI for Good activities and the AI for Good digital platform remains integral to the activities of such focus groups and initiatives.

**Programming streams:** AI for Good features near-daily [programming](https://aiforgood.itu.int/programme/) with the following programming streams.

Learn:

* AI for Good Keynotes
* AI for Good Webinars
* AI for Good Discovery
* AI for Good Perspectives
* AI for Good Blog

Build:

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

Connect:

* AI for Good Global Summit
* AI for Good Artistic Intelligence
* UN AI Actions
* AI for Good Brain Trust
* AI for Good Neural Network

**ITU AI/ML Challenges:** ITU's AI/ML Challenges are competitions where anyone can participate to solve problem statements related to communication networks or geospatial data analysis. The competitions enable participants to connect with new partners – and new tools and data resources ­– to achieve goals set out by problem statements contributed by industry and academia.

These competitions have welcomed over 4,000 participants from more than 100 countries since their launch in 2020.

The competitions are stimulating global access to AI/ML expertise and capabilities. The competitions empower participants to create, train, and deploy ML models by offering curated problem statements, data, technical webinars, mentoring, and hands-on training sessions. This enhances participants' skills and global recognition and also supports a more inclusive ITU standardization process by paving the way for participants to make valuable contributions to ITU's specifications.

[The fourth edition of the ITU AI/ML in 5G Challenge](https://aiforgood.itu.int/about-ai-for-good/aiml-in-5g-challenge/) – which will remain in focus throughout the year (including as part of a [series of AI for Good webinars](https://aiforgood.itu.int/eventcat/ai-ml-in-5g/)) – will culminate with a Grand Challenge Finale on 13 December 2023.

More than half of the participants in 2022 were students, with a large majority not yet ITU members (see figures 2 and 3).

To share the solutions with the larger community, solutions submitted are shared as open source in several repositories on the Challenge GitHub: <https://github.com/ITU-AI-ML-in-5G-Challenge>.

In addition, the [ITU Journal on Future and Evolving Technologies](https://www.itu.int/en/journal/j-fet/Pages/default.aspx) has published two special issues on "AI/ML solutions in 5G and future networks" sharing solutions and learnings from participants and Challenge hosts (the originators of the problem statements) in 2020 and 2021. A third special issue is currently being prepared.

Figure 2 – Participants identifying as students and professionals

Figure 3 – Participants with and without ITU membership

## 5.2 Digital financial inclusion and fintech

For an overview of all TSB/ITU-T activities on digital financial inclusion and fintech, see dedicated [web page](https://www.itu.int/en/ITU-T/dfs/Pages/default.aspx).

**Status of digital financial services (DFS) security recommendations' adoption:** Through the activities of the [ITU DFS Security Lab](https://figi.itu.int/figi-resources/dfs-security-lab/),TSB is following up on the outreach with telecom regulators of emerging economies and regional telecommunication regulatory bodies during the reporting period to present the security recommendations for DFS developed under the [Financial Inclusion Global Initiative (FIGI)](https://figi.itu.int/), inviting them to adopt the recommendations.

In addition, the Communication Regulators Association of Southern Africa (CRASA), the East African Communications Organisation (EACO), and the West Africa Telecommunications Regulators Assembly (WATRA) have officially confirmed they are adopting the security recommendations at their respective regional levels.

**DFS Security Lab:** The [ITU DFS Security Lab](https://figi.itu.int/figi-resources/dfs-security-lab/) set up as part of FIGI activities developed a methodology for conducting security tests for mobile payment apps based on USSD, STK, and Android.

The 2023 activities of the DFS security lab are supported by funding from Deutsche Gesellschaft für Internationale Zusammenarbei (GIZ) and Korea's Ministry of Science and ICT.

As part of the activities of the ITU DFS Security Lab, [ITU DFS ​Security Clinics](https://figi.itu.int/itu-dfs-security-clinics/) offer guidance to regulators and DFS providers on adopting the security best practices developed under FIGI. The DFS Security Lab helps stakeholders to verify that these best practices are being followed.

The DFS Security Lab conducted 3 security clinics, welcoming 200 participants, in the reporting period:

* [Eastern Caribbean](https://www.itu.int/en/ITU-T/webinars/dfs/sc/20230119/Pages/default.aspx), 17-19 January 2023, hosted by UNCDF-EU-OACP Partnership for Digital Financial Inclusion, physical event in Trinidad and Tobago
* [East Africa](https://www.itu.int/en/ITU-T/webinars/dfs/sc/20230208/Pages/default.aspx), 8-9 February 2023, hosted by EACO online.
* [FIDO authentication online workshop](https://www.itu.int/en/ITU-T/Workshops-and-Seminars/2022/1201/Pages/default.aspx), 1-2 December 2022, hosted by Superintendencia de Banca, Seguros y AFP del Perú

As part of the activities of the DFS Security Lab, ITU also conducts knowledge transfer programme to support telecom regulators in emerging economies in establishing their own security labs and to implement the security methodology to conduct security audits of mobile payment applications based on USSD, iOS, and Android. ITU has received requests in 2022 from Tanzania, Peru and Uganda Telco regulators for the knowledge transfer programme.

The status of the knowledge transfer sessions across Peru, Tanzania, and Uganda is as follows:

* In Uganda and Tanzania, the knowledge transfer sessions intended for conducting security tests on mobile payment applications have been completed. They are now in the oversight period which will end in December 2023.
* In Peru, the knowledge transfer sessions for performing security tests on USSD and Android-based mobile payment applications have been finalized. The sessions for iOS testing are yet to be conducted. The oversight period for testing has already started.

A new request for knowledge transfer was received from The Gambia telecom regulator, PURA, in May.

Following a tender exercise in January 2023, ITU awarded a contract for the development of a Cyber Resilience Assessment Toolkit for DFS critical infrastructure to Deloitte. The toolkit is currently under development and will be ready in July 2023.

The DFS Security lab is developing a knowledge-sharing platform on DFS security which aims to promote collaboration among regulators and other DFS stakeholders, aiding them in the implementation of security guidelines and maintaining up-to-date best practices for Digital Financial Services.

The objectives of the Knowledge Sharing Platform are as follows:

* Collaborate with ITU to keep up to date the DFS security assurance framework security controls and DFS security recommendations.
* Share experiences, challenges, and lessons learned from the implementation of security measures across various jurisdictions.​
* Communicate directly with their peers on issues relating to security of digital financial services.

**Collaboration with UPU:** Under WTSA Resolution 11, a joint DFS working group between ITU and UPU secretariat meets quarterlyto share information about events and activities being implemented by each organisation related to DFS and possible collaboration on participation in the events. The existing MOU between ITU and UPU is currently being reviewed.

**Digital currency:** The [Digital Currency Global Initiative](https://www.itu.int/en/ITU-T/extcoop/dcgi/Pages/default.aspx) is a collaboration between ITU and Stanford University established in July 2020. The initiative is an open platform for dialogue and research on pilot implementations of digital currency and the development of specifications for technical standards to foster adoption, universal access, and ultimately financial inclusion.

The second edition of the [DC3 Conference: From Cryptocurrencies to Central Bank Digital Currencies](https://www.itu.int/en/ITU-T/Workshops-and-Seminars/2023/0124/Pages/default.aspx), 24-27 January 2023 online, highlighted the work of the Digital Currency Global Initiative as well as emerging industry trends and initiatives in digital currencies, particular with regard to:

* The latest trends in central bank digital currency, cryptocurrency, and stablecoins.
* Emerging developments and areas where standards are needed for the architecture and interoperability of digital currencies and their integration with existing payment systems.
* Topics such as interoperability for central bank digital currencies and stablecoins and securing digital currency systems.
* Fostering dialogue among digital currency ecosystem stakeholders and regulators on key lessons learned from pilot implementations of digital currencies.

## 5.3 Digital transformation for smart cities and communities

The [United for Smart Sustainable Cities (U4SSC)](http://www.itu.int/en/ITU-T/ssc/united/Pages/default.aspx) initiative is supported by 19 UN bodies with the aim of achieving the SDG11 ("Make cities and human settlements inclusive, safe, resilient and sustainable").

Over 150 cities worldwide are evaluating their progress towards smart city objectives and the SDGs using [U4SSC Key Performance Indicators for Smart Sustainable Cities](https://www.itu.int/en/ITU-T/ssc/united/Pages/publication-U4SSC-KPIs.aspx) based on ITU standards. The results of the KPI evaluations are shared by [city snapshots, factsheets, verification reports and case studies](https://www.itu.int/en/ITU-T/ssc/united/Pages/publication-U4SSC-KPIs.aspx).

U4SSC is developing expert guidance on topics including:

* Digital city platforms to support the digital transformation of public services and their integrated management as well as studying the impact of multiverse in cities.
* Cities’ resilience in the face of emergencies such as COVID-19 and routes to economic and financial recovery.
* Public procurement in the digital age to support city leaders in establishing effective processes for the procurement of ICT solutions for smart cities.
* Tools and mechanisms to finance smart city projects, benefiting from the contributions of a wide variety of smart city stakeholders in the public and private sectors.
* The potential for frontier technologies to contribute to smart city innovation, looking at smart city use cases of technologies in fields such as AI and blockchain.
* Developing AI frameworks and guidelines addressing principles, enablers, and governance for applying AI solutions, while taking into consideration targets set in the SDGs and other international commitments.
* Enabling people-centred cities through digital transformation, aiming to provide guidance and a series of policy-based recommendations and assessment frameworks for driving digital transformation in an urban context, while improving smart and sustainable city governance.

[Two new U4SSC reports](https://u4ssc.itu.int/publications/) were published in the reporting period:

* Procurement guidelines for smart sustainable cities (May 2023): The guidelines support city officials and their partners in embracing digital commercial approaches that support achieving the SDGs.
* Compendium of practices on innovative financing for smart sustainable cities projects (January 2023): The compendium provides a practical insight on the types of projects that can improve sustainability and smartness of a city, combined with ideas on how they can be financed.

[Three new ITU reports](https://www.itu.int/cities/publications/) were published in the reporting period:

* Executive briefing on the metaverse (May 2023): The briefing provides a concise overview of the technologies that underpin metaverse, as well as the key challenges and opportunities.
* Building a people-centered digital future for cities and communities (May 2023):The brochure showcases ITU’s commitment to creating an inclusive, accessible and sustainable digital future, offering an overview of ITU initiatives and standards supporting digital transformation.
* The role of digital technologies in aging and health (May 2023): Developed by ITU and the Pan American Health Organization and International Telecommunication Union, the report describes opportunities to improve the lives of older persons with the help of inclusive technology solutions.

The [ITU webinar series on digital transformation](https://www.itu.int/en/ITU-T/webinars/dt4cc/Pages/default.aspx) featured the following webinars in the reporting period:

* [STI Forum side event on leveraging the metaverse in cities to  
  achieve the SDGs](https://www.itu.int/cities/standards4dt/ep25/), Episode #25, 4 May 2023, co-organized with Saudi Arabia
* [STI Forum side event on building back smarter and more sustainable cities through the United for Smart Sustainable Cities initiative](https://www.itu.int/cities/standards4dt/ep24/), Episode #24, 3 May 2023, co-organized with the U4SSC Austrian Country Hub and Tanzania in partnership with the Permanent Mission of Austria to the United Nations in New York
* [STI Forum side event on building the pathway to sustainable  
  digital transformation](https://www.itu.int/cities/standards4dt/ep23/), Episode #23, 2 May 2023, co-organized with RURA
* [Digital water in smart sustainable cities](https://www.itu.int/cities/standards4dt/ep22/), Episode #22, 14 March 2023, co-organized with the WMO and UN-Water
* [Digital Agriculture: Driving Digital Transformation for Food Security](https://www.itu.int/cities/?page_id=550&preview=true), Episode #21, 17 February 2023, co-organized with FAO and ISO
* [A one-of-a-kind platform for digital transformation: the U4SSC Austrian Country Hub](http://www.itu.int/cities/ep20), Episode #20, 7 December 2022, co-organized with the U4SSC Austrian Country Hub
* [Tourism in smart cities: Reimagining the road to digital tourism](http://www.itu.int/cities/ep19), Episode #19, 7 December 2022, co-organized with UNWTO and UNE

## 5.4 Intelligent transport systems

The [ITU-UNECE Future Networked Car Symposium](https://fnc.itu.int/) was held online from 13 to 16 March 2023. The annual symposium examines the latest advances in vehicle connectivity, automated mobility and the role of Artificial Intelligence in ​the transport sector, sharing unique insight into associated implications for technology, business and regulation.

The ITU-led [Collaboration on ITS Communication Standards (CITS)](https://www.itu.int/en/ITU-T/extcoop/cits/Pages/default.aspx) is a forum supporting the coordination of an internationally accepted, globally harmonized set of Intelligent Transportation Systems (ITS) communication standards of the highest quality in the most expeditious manner possible to enable the rapid deployment of fully interoperable ITS communication-related products and services in the global marketplace.

CITS meetings are typically held twice a year, in March and September, and often organized back-to-back with other ITS events, e.g., annual ITU-UNECE Future Networked Car Symposia, that also provide opportunities to exchange information and keep experts updated on ITS standardization. The representatives of involved standards bodies are invited to submit status reports on ITS standardization ongoing in their respective organizations to CITS meetings.

CITS maintains the global [ITS Communication Standards Database](https://www.itu.int/net4/ITU-T/landscape#?topic=0.131&workgroup=1&searchValue=&page=1&sort=Revelance). The database is designed to assist the harmonization of ITS standards and includes standards developed by all relevant standards bodies, providing a reference to all standards supporting connected vehicles and automated driving.

## 5.6 CTO and CxO meetings

[CTO and CxO meetings](http://www.itu.int/en/ITU-T/tsbdir/cto/Pages/default.aspx) bring together high-level industry executives together with the senior management of TSB to exchange views on industry priorities and related standardization activities.

The most recent [CxO Meeting](https://www.itu.int/en/ITU-T/tsbdir/CxO/Pages/CxO-20221206.aspx) was held on 6 December 2022 at the Telecom Review Leader's Summit in Dubai, United Arab Emirates, with additional participation online, hosted by Telecom Review with the support of the UAE Telecommunications and Digital Government Regulatory Authority, du, TELUS, IBM, and Huawei.

CxOs discussed industry priorities in the areas of AI and machine learning, environmental sustainability, sustainability reporting, the metaverse, quantum information technologies, and IMT-2020/5G and beyond. CxOs also shared views on means to support and capitalize on the growing synergy between industry and academia in the development and application of ICTs, particularly in the field of AI and machine learning. See meeting [communiqué](https://www.itu.int/en/ITU-T/tsbdir/cto/Documents/Communique_ITU_CxO_2022_06.12_Final.pdf).

# 6 Academia

[ITU Academia membership](https://www.itu.int/hub/membership/), the [ITU Journal on Future and Evolving Technologies](https://www.itu.int/en/journal/j-fet/Pages/default.aspx), and [ITU Kaleidoscope conferences](https://www.itu.int/en/ITU-T/academia/kaleidoscope/Pages/default.aspx) form key avenues for academics to engage in ITU’s work.

## 6.1 ITU Journal

The [ITU Journal on Future and Evolving Technologies (ITU J-FET)](https://www.itu.int/en/journal/j-fet/Pages/default.aspx) – free of charge to both readers and authors – offers comprehensive coverage of communications and networking. The online journal welcomes research submissions on all relevant topics, all year long.

The journal includes [recorded webinar discussions](https://www.itu.int/en/journal/j-fet/webinars/Pages/default.aspx) with internationally renowned researchers. A special series of journal webinars beginning on 6 June 2023 will share insights from CTOs on industry ambitions for 5G, 6G, and associated innovations to boost network intelligence.

The latest issue of the journal, published in March 2023, features research on innovative network solutions for future services, intelligent surfaces, and gigahertz-to-terahertz (GHz-to-THz) broadband communications for 6G non-terrestrial networks.

The previous issue, published in December 2022, features research on the digital continuum and next-generation networks, networking beyond 2030, and autonomous network management and control for 6G time-critical applications.

Upcoming issues in 2023 are set to address:

* AI-driven security in 5G and beyond
* Network virtualization, slicing, orchestration, fog and edge platforms for 5G and 6G wireless systems
* AI for accessibility
* Metaverse: Communications, networking and computing
* AI and machine learning solutions in 5G and future networks
* Intelligent technologies for future networking and distributed systems

## 6.2 ITU Kaleidoscope academic conferences

The [ITU Kaleidoscope](https://www.itu.int/en/ITU-T/academia/kaleidoscope/Pages/default.aspx) series of peer-reviewed academic conferences – organized with the technical co-sponsorship of the Institute of Electrical and Electronics Engineers (IEEE) and the IEEE Communications Society – calls for original research on topics of growing strategic relevance to ITU-T.

The [14th edition](https://www.itu.int/en/ITU-T/academia/kaleidoscope/2022/Pages/default.aspx) – themed "Extended reality – How to boost quality of experience and interoperability" – explored the innovation required to make the metaverse a reality. The conference took place in Accra, Ghana, 7-9 December 2022, hosted by the National Communications Authority of Ghana.

# 7 Cooperation and coordination

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

## 7.1 International standardization bodies

[World Standards Cooperation (WSC)](https://www.itu.int/en/ITU-T/extcoop/Pages/wsc.aspx)

The World Standards Cooperation (WSC) was established in 2001 by the International Telecommunication Union (ITU), the International Organization for Standardization (ISO), and the International Electrotechnical Commission (IEC) in order to strengthen and advance the voluntary consensus-based international standards systems of ITU, ISO, and IEC.

* A WSC meeting hosted by ITU on 24 February 2023 discussed the relationship between international standardization and human rights, welcoming the UN High Commissioner for Human Rights, Volker Türk.
* [World Standards Day](https://www.worldstandardsday.org/home.html), 14 October: ITU, ISO and IEC lead the celebrations of World Standards Day. "A Shared Vision for a Better World" is the theme of World Standards Day, continuing a multi-year campaign launched in 2021 aimed at raising awareness of how international standards contribute to the SDGs. [All past editions of World Standards Day](https://www.worldstandardscooperation.org/what-we-do/world-standards-day/).
* [G20 International Standards Summits](https://www.worldstandardscooperation.org/g20/g20-2022/): ITU, ISO and IEC together arrange events as part of G20 activities on the value of international standards to sustainable development. Three such events have been held under the G20 Presidencies of Indonesia (2022), Italy (2021) and Saudi Arabia (2020).

[Technical coordination mechanism among IEC, ISO and ITU-T/ITU-R (including ISO/IEC JTC1)](https://www.itu.int/en/ITU-T/extcoop/Pages/WSC-coordination.aspx)

IEC, ISO and ITU-T/ITU-R have agreed that four coordination levels are to be followed when an issue regarding collaboration is identified (source: [TSAG TD138](https://www.itu.int/md/T13-TSAG-140617-TD-GEN-0138/en)).

[Global Standards Collaboration (GSC)](https://www.itu.int/en/ITU-T/gsc/Pages/default.aspx)

GSC is an unincorporated voluntary organization dedicated to enhancing global cooperation and collaboration regarding communications standards and the related standards development environment. The 23rd meeting of GSC was held in London, UK, 26-27 April, hosted by ETSI.

[IEC SMB/ISO TMB/ITU-T TSAG Standardization Programme Coordination Group (SPCG)](https://www.worldstandardscooperation.org/what-we-do/standards-programme-coordination-group-spcg/)

The IEC SMB/ISO TMB/ITU-T TSAG Standardization Programme Coordination Group (SPCG) was established in 2018 by ISO TMB, IEC SMB, and ITU-T TSAG, and conducts strategic coordination of future standardization work, coordination of existing standardization work, short-term related tasks identified by the SPCG and approved by the technical boards of IEC, ISO and ITU-T. The approved SPCG terms of reference are [here](https://www.itu.int/en/ITU-T/extcoop/Documents/tor/ToR_SPCG.pdf).

[IEC-ISO-ITU Joint Smart Cities Task Force (J-SCTF)](https://www.itu.int/hub/2020/10/new-smart-city-standards-joint-task-force-established-by-itu-iso-and-iec/)

J-SCTF was established in 2020 and supports the coordination of IEC, ISO and ITU-T work on smart city standardization. It aims to ensure standardization solutions for smart cities are comprehensive, capitalizing on synergies among IEC, ISO and ITU-T. IEC hosts the J-SCTF document [repository](https://collaborate.iec.ch/#/pages/workspaces/735898/dashboard).

## 7.2 National and regional standardization bodies

ITU-T/TSB has become more visible to national and regional standardization bodies, as well as built on and enhanced good collaboration with ITU Regional and Area Offices.

TSB facilitates an ITU-T presence in the activities of national and regional standardization bodies, as well as encourages national and regional standardization bodies' participation in ITU-T activities.

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

Standardization bodies with which TSB has expanded cooperation include:

* African Regional Organization for Standardisation (ARSO)
* Pan American Standards Commission (COPANT)
* Pacific Area Standards Congress (PASC)
* Asia-Pacific Telecommunity Standardization Program (ASTAP)
* South Asian Regional Standards Organization (SARSO)
* GCC Standardization Organization (GSO)
* European Committee for Standardization (CEN) and European Committee for Electrotechnical Standardization (CENELEC)
* European Telecommunications Standards Institute (ETSI)

## 7.3 TSB and ITU Regional and Area Offices

ITU Regional Offices regularly share information with the TSB Director on regional activities relevant to standardization and provide regular reports to TSAG.

At the initiative of the TSB Director, regular conference calls and face-to-face meetings are arranged between the ITU Regional and Area Offices and TSB senior management, covering overviews, updates, and briefings on activities organized by each TSB department in the Regions.

These efforts, as well as the establishment of a TSB Focal Point for the Regions, have supported improvements in coordination with ITU Regional and Area Offices with respect to standardization activities, operations, and events across the Regions.

## 7.4 ITU Sectors

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

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

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

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

## 7.5 External cooperation

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

[Collaboration on ITS Communication Standards (CITS)](https://www.itu.int/en/ITU-T/extcoop/cits/Pages/default.aspx)

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

[Digital Currency Global Initiative](https://www.itu.int/en/ITU-T/extcoop/dcgi/Pages/default.aspx)

The Digital Currency Global Initiative (DCGI) is collaboration between ITU and the Future of Digital Currency Program of Stanford University. DCGI continues the dialogue and research initiated by [FG DFC](https://www.itu.int/en/ITU-T/focusgroups/dfc/Pages/default.aspx) on pilot implementations, use cases, applications and developing specifications for technical standards that will foster adoption, universal access and ultimately financial inclusion. The goals of DCGI are to drive the synergistic engagement, innovative use, and standardization of digital currencies, which are the three pillars of the Initiative.

[FIGI resources for strong authentication](https://www.itu.int/en/ITU-T/extcoop/FIGIresources/authentication/Pages/default.aspx)

This is a compendium of resources for developers, provided under the Financial Inclusion Global Initiative (FIGI) to help foster the adoption of strong password-less authentication for user login and transaction confirmation especially for digital financial services. The resources mainly focus on demonstrating how easy and fast it is to eliminate the use of passwords with Recommendation ITU-T X.1277 that describes the Fast Identity Online (FIDO) Universal Authentication Framework.

[Financial Inclusion Global Initiative (FIGI) Symposium](https://www.itu.int/en/ITU-T/extcoop/figisymposium/Pages/default.aspx)

Three FIGI Symposium were held in 2017, 2019 and 2021 to provide a forum for dialogue regulators from telecom and financial services, DFS providers and all concerned stakeholders to share their experience and views on the main challenges to be addressed for scaling up DFS.

[Global Initiative on AI and Data Commons](https://www.itu.int/en/ITU-T/extcoop/ai-data-commons/Pages/default.aspx)

The Global Initiative on AI and Data Commons brings together AI specialists and data owners from industry, academia, member states, UN agencies and civil society to develop knowledge, specifications and guidelines to scale AI solutions with the help of shared datasets, testing and simulation environments, collaborative sandboxes, AI models and associated software, data discoverability and storage and computing resources.

[ITU-T and WSIS](https://www.itu.int/en/ITU-T/wsis/Pages/default.aspx)

As the UN specialized agency for ICTs, ITU was proud to have played the leading role in the organization of the [World Summit on the Information Society (WSIS)](https://www.itu.int/wsis/index.html). The alignment of ITU-T work with the WSIS Action Lines will be reported to this meeting of TSAG as part of the ITU Operational Plan.

ITU-T work relates mainly to WSIS Action Lines C2 (infrastructure) and C5 (security) – where ITU is the lead facilitator – but also to WSIS Action Lines C3 (access to information and knowledge), C4 (capacity building), C6 (enabling environment), C7 (applications), C8 (cultural diversity), and C11 (international and regional cooperation).

ITU-T/TSB facilitated discussions at WSIS Forum 2023 on topics including fibre-optic broadband networks, gender-responsive standards, smart sustainable cities and communities, circular economy and biodiversity.

[ITU/WMO/UNESCO-IOC Joint Task Force on SMART cable systems](https://www.itu.int/en/ITU-T/climatechange/task-force-sc/Pages/default.aspx)

ITU, the Intergovernmental Oceanographic Commission of the United Nations Educational, Scientific and Cultural Organization (UNESCO-IOC), and the World Meteorological Organization (WMO) established the Joint Task Force (JTF) on SMART cable systems in 2012, dedicated to advancing the concept of ‘Science Monitoring And Reliable Telecommunications (SMART) cables’. The minimum set of requirements established by the JTF are now feeding into ITU-T standardization work, with two new work items established in 2021 on SMART submarine cable systems ([G.smart](https://www.itu.int/ITU-T/workprog/wp_item.aspx?isn=17089)) and dedicated scientific sensing submarine cable system ([G.dsssc](https://www.itu.int/ITU-T/workprog/wp_item.aspx?isn=17090)).

[Recognized standards-developing organizations (SDOs) under Recs. A.4, A.5 and A.6](https://www.itu.int/en/ITU-T/extcoop/Pages/sdo.aspx)

ITU-T's external cooperation is guided by three ITU-T Recommendations: [ITU-T A.4:](https://www.itu.int/rec/T-REC-A.4) procedures for communicating with forums and consortia, [ITU-T A.5:](https://www.itu.int/rec/T-REC-A.5) making reference to documents from other organizations, [ITU-T A.6:](https://www.itu.int/rec/T-REC-A.6) cooperation and exchange of information with national and regional SDOs.

# 8 Conformity and interoperability programme

The [ITU Conformity and Interoperability (C&I) programme](https://www.itu.int/en/ITU-T/C-I/Pages/default.aspx) aims to enhance the conformity and interoperability of ICT products implementing ITU-T Recommendations or part thereof, solicit feedback to improve the quality of ITU-T Recommendations, and reduce the digital divide and standardization gap by assisting developing countries with human resource and infrastructure capacity building.

Testing labs can now obtain official recognition from ITU for their competence to test the conformance of products with ITU-T Recommendations ([TSB Circular 368](https://www.itu.int/md/meetingdoc.asp?lang=en&parent=T17-TSB-CIR-0368)). A first 11 testing labs have been listed in the new [ITU Testing Laboratories Database](https://itu.int/go/tldb) for ITU-recognized facilities. For buyers seeking standards-based solutions, the complementary [ITU Product Conformity Database](http://www.itu.int/net/itu-t/cdb/ConformityDB.aspx) lists products compliant with ITU-T Recommendations.

ITU-T determined the key criteria and [recognition procedure](https://www.itu.int/en/ITU-T/studygroups/com11/casc/Documents/TL-RP_pub_2022-07-15.pdf) for testing labs.

An earlier [Memorandum of Understanding](https://www.itu.int/en/ITU-T/extcoop/Documents/mou/MoU-ITU-T-IAF-ILAC-20220824.pdf) between ITU-T, the International Laboratory Accreditation Cooperation (ILAC) and the International Accreditation Forum (IAF) facilitates ITU's recognition of labs accredited by signatories to the [ILAC Mutual Recognition Arrangement](https://ilac.org/ilac-mra-and-signatories/).

Testing labs are invited to apply for ITU recognition using this [application form](https://www.itu.int/net/itu-t/cdb/secured/reg-tldb.aspx). Labs successful in their application are announced in the [ITU Operational Bulletin](https://www.itu.int/pub/T-SP).

Companies can apply for the inclusion of their products – products tested to applicable ITU-T Recommendations using ITU-T test specifications or procedures adopted by an SDO or forum qualified in accordance with Recommendation ITU-T A.5 – in the ITU Product Conformity Database using this [application form](https://www.itu.int/net/itu-t/cdb/secured/Register16.aspx). All criteria for populating the database are listed [here](https://www.itu.int/en/ITU-T/C-I/conformity/Pages/cdb.aspx).

The recognition procedure is supported by the [ITU-T Conformity Assessment Steering Committee](https://www.itu.int/en/ITU-T/studygroups/com11/casc/Pages/default.aspx" \t "_blank).

The testing lab recognition scheme is the latest initiative under ITU’s C&I programme. ITU-T SGs continue developing ITU-T Recommendations defining testing requirements and test suites. Along with conformity assessments, the programme organizes interoperability testing events, offers capacity building, and provides technical assistance in the establishment of testing centres.

# 9 Mainstreaming accessibility

ITU works to increase access to ICTs for persons with disabilities by raising awareness of their right to access ICTs, mainstreaming accessibility in the development of international ICT standards, and providing education and training on key accessibility issues.

For an overview of all ITU activities relevant to accessibility, see [ITU and Accessibility](https://www.itu.int/en/action/accessibility/Pages/hlmdd2013.aspx). For an overview of TSB/ITU-T activities relevant to accessibility, see [ITU-T and Accessibility](https://www.itu.int/en/ITU-T/accessibility/Pages/default.aspx).

# 10 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 Common 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).

The group's long-serving rapporteurs – Serge Raes, Orange; Amy Marasco, Microsoft; and Hung Ling, Nokia – stepped down at the end of 2022. The TSB Director has appointed Gaëlle Martin-Cocher, Interdigital, and Olivier Dubuisson, Orange, as the group's new rapporteurs.

No meetings were held in the reporting period. Previous meeting reports are available [here](https://www.itu.int/oth/T0402/en).

All patent declarations received are listed on ITU’s website. See the [ITU-T IPR database](https://www.itu.int/net4/ipr/search.aspx).

# 11 Membership

ITU-T currently hosts 268 Sector Members and 223 Associates. ITU Academia members now total 172. 56 of ITU-T's Associates are now participating under the reduced fee structure for small and medium-sized enterprises (SMEs) which came into effect on 31 January 2020.

**New Sector Members welcomed in the reporting period:**

Ant Group Co., Ltd; CableLabs; China Satellite Network Group Co., Ltd; DITO Telecommunity Corporation; Frontier Communications; World’s Global Telecom SA; Emirates Integrated Telecommunications Company PJSC; Vecima Networks.

**New Associates welcomed in the reporting period:**

GibFibre Ltd (SG2); BBIX Singapore Pte. Ltd. (SG2); Onomondo ApS (SG2); iONLINE Internet Solutions Provider Ltd (SG2); Mozilla Corporation (SG3); InnoLight Technology (Suzhou) Ltd. (SG15); Net Insight AB (SG15).

**Total ITU-T Sector Members, Associates and Academia (31 December 2009 – 19 May 2022):**

The following table and figure illustrate the evolution of ITU-T membership from 31 December 2009 to 19 May 2023 (noting that the Academia membership category opened in 2011).

|  | **2009** | **2010** | **2011** | **2012** | **2013** | **2014** | **2015** | **2016** | **2017** | **2018** | **2019** | **2020** | **2021** | **2022** | **2023** |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Sector Members | 286 | 256 | 258 | 263 | 270 | 267 | 262 | 251 | 256 | 256 | 265 | 275 | 269 | 263 | 268 |
| Associates | 101 | 111 | 119 | 128 | 130 | 132 | 131 | 127 | 135 | 153 | 179 | 194 | 216 | 223 | 223 |
| Academia | ‑ | ‑ | 22 | 39 | 56 | 70 | 92 | 104 | 120 | 147 | 156 | 160 | 159 | 171 | 172 |
| TOTAL | 387 | 367 | 399 | 430 | 456 | 469 | 485 | 482 | 511 | 556 | 600 | 629 | 644 | 657 | 663 |

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

**Figure 4 – Evolution of ITU-T membership from 31 December 2009 to 19 May 2023**

NOTE – The Academia category was created in 2011.

# 12 Bridging the standardization gap

[ITU's Bridging the Standardization Gap (BSG) programme](https://www.itu.int/en/ITU-T/gap/Pages/default.aspx) improves the capacity of developing countries to participate in the development and implementation of international ICT standards.

The BSG Programme is structured around five pillars: Engagement, know-how, community, awareness, and partnering.

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

**BSG hands-on training sessions:** ITU-T regularly carries out "BSG Hands-On SG effectiveness training" focused on the development of practical skills to maximize the effectiveness of developing countries' participation in the ITU-T standardization process. These training sessions cover topics including strategies for participation in SGs, drafting contributions to meetings, presenting proposals, collaborative working methods, building consensus and utilization of TSB tools and services.

Nine BSG training sessions were held in the reporting period:

* SG5RG-AFR, Kampala, Uganda, 15-19 May 2023
* SG11, Geneva, 10-19 May 2023
* Training for delegates from Pakistan, e-meetings, 2 and 5 May 2023
* SG13, Geneva, 13-24 March 2023
* SG3, Geneva, 1-10 March 2023
* SG17, Geneva, 21 February - 3 March 2023
* SG20, Geneva, 30 January - 10 February 2023
* SG3RG-ARB, Manama, Bahrain, 30-31 January 2023
* SG2RG-AFR training on numbering resources management, e-meeting, 17-18 January 2023

**BSG training on services and tools:** On occasion, TSB also offers trainings on the use of TSB services and tools. These trainings introduce services and tools including remote participation, MyWorkspace and publications. Such BSG trainings facilitate more active and efficient participation in ITU-T work. For more on TSB services and tools, see [section 14](#_14_Services_and).

**Regional groups:** Regional groups within ITU-T SGs have proven effective mechanisms to coordinate regional contributions to ITU and increase the number and quality of technical contributions from developing countries. Stimulating effective participation in ITU-T SGs, regional groups play a key role in bridging the standardization gap between developed and developing countries. An overview of regional groups' activities can be found [here](https://www.itu.int/en/ITU-T/regional-groups/Pages/default.aspx).

Seven regional group meetings were organized in the reporting period:

* SG17 Regional Group for the Arab Region, Cairo, Egypt, 18 May 2023
* SG5 Regional Group for Africa, Kampala, Uganda, 15-17 May 2023
* SG12 Regional Group for Africa, Banjul, Gambia, 15-16 March 2023
* SG3 Regional Group for Africa, Brazzaville, Republic of the Congo, 7-9 February 2023
* SG3 Regional Group for the Arab Region, Manama, Bahrain, 30-31 January 2023
* SG3 Regional Group for Asia and Oceania, e-meeting, 23 January 2023
* SG2 Regional Group for Africa, e-meeting, 17-18 January 2023

ITU-T hosts 24 regional groups:

* Eight for Africa (SGs 2, 3, 5, 11, 12, 13, 17, and 20)
* Four for the Americas (SGs 2, 3, 5, and 20)
* Five for the Arab States (SGs 2, 3, 5, 17, and 20)
* Two for Asia and the Pacific (SGs 3 and 5)
* One for Europe and the Mediterranean Basin (SG3)
* Four for Eastern Europe, Central Asia and Transcaucasia (SGs 3, 11, 13, and 20)

**Regional Standardization Forums:** [Regional Standardization Forums (RSFs)](https://www.itu.int/en/ITU-T/Workshops-and-Seminars/bsg/Pages/default.aspx) and Inter-regional Standardization Forums provide tutorials on ITU-T working methods as well as more technically-oriented themes. RSFs are being held in conjunction with meetings of regional groups to improve the alignment of RSF discussions and the priorities of ITU-T SGs. RSFs are also raising awareness of ITU standardization activities through the participation of key decision-makers (Prime Ministers, Ministers, Heads of Regulators, CEOs, etc.).

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

**e-Learning courses:** The [training course](https://academy.itu.int/training-courses/full-catalogue/recommendation-itu-t-a1-working-methods-itu-t-study-groups-1) on [Recommendation ITU-T A.1 "Working methods for study groups of the ITU Telecommunication Standardization Sector"](https://www.itu.int/itu-t/recommendations/rec.aspx?rec=13851) was updated following WTSA-20. All training courses are available on the ITU Academy website at <http://academy.itu.int>.

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

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

**Fellowships:** Fellowships provide financial support to ITU-T delegates from eligible developing countries to assist their participation in ITU-T meetings. 136 fellowships and e-fellowships were requested from December 2022 to March 2023. 73 were awarded and 60 were used. The figures below illustrate the distribution of the awarded fellowships by region and gender, for December 2022 to March 2023 as well as the previous study period.

**Figure 5 – Awarded fellowships by region (December 2022 to March 2023)**

**Figure 6 – Awarded fellowships by gender (December 2022 to March 2023)**

**Figure 7 – Awarded fellowships by region in the previous study period**

**Figure 8 – Awarded fellowships by gender in the previous study period**

NOTE: No fellowships were awarded in the all-online meeting environment called for by the COVID-19 pandemic.

# 13 Gender

TSB continues its efforts to include a gender perspective in all of its activities and programmes under the umbrella of the ITU Gender Task Force. TSB continues to undertake actions to improve gender equality in TSB and ITU-T. Diversity of staff, gender equality and the empowerment of women continue to be among TSB's priorities.

TSB has conducted survey to collect more insights from ITU-T members on various ways to accelerate the improvement of gender balance in all areas of ITU-T’s work and its committees. The results are currently being compiled.

In accordance with the [UNECE Declaration on Gender Responsive Standards](https://unece.org/gender-responsive-standards-initiative), which was endorsed by ITU along with other major standards bodies, TSB is inviting ITU-T members and staff involved in standards-development processes to undertake a [training course](https://learnqi.unece.org/courses/gender-responsive-standards/) on gender-responsive standards development. Members and staff are invited to send certificates of completion to [wise@itu.int](mailto:wise@itu.int).

A [WSIS Forum session on Gender Responsive Standards](https://www.itu.int/net4/wsis/forum/2023/Agenda/Session/476) organized by ITU, UNECE, ISO, IEC and Canada was held online on 4 May 2023.

The figures below provide an overview of TSB/ITU-T activities with respect to participants' gender.

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Figure 9.1, 9.2 and 9.3 – Participation in statutory events by study period and gender

Figure 10.1 and 10.2 – Current share of ITU-T leadership positions by gender

Figure 11 - Awarded fellowships by gender (December 2022 to March 2023)

|  |  |  |
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Figures 12.1, 12.1 and 12.3 – Current TSB staff positions by gender, overall, in the professional and director service categories, and in the general service category

# 14 Publications

## 14.1 Recommendations and Supplements

Over 8,000 pages of ITU-T Recommendations and Supplements were published in the reporting period. Figure 16 illustrates the number of ITU-T Recommendations and Supplements published per year since 2018.

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

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

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**Figure 13 – Number of Recommendations, amendments and Supplements**   
**published per year since 2018**

## 14.1.1 Recommendations deleted between WTSAs

Since March 2022, the following ITU-T Recommendations were deleted in accordance with clause 9.8.2.2 of WTSA Resolution 1 (Rev., Geneva, 2022):

* Recommendation ITU-T D.212 "Charging and accounting principles for the use of Signalling System No. 7"
* Recommendation ITU-T K.43 "Immunity requirements for telecommunication network equipment"
* Recommendation ITU-T K.48 "EMC requirements for telecommunication equipment – Product family Recommendation"
* Recommendation ITU-T K.88 "EMC requirements for next generation network equipment"
* Recommendation ITU-T D.280 "Principles for charging and billing, accounting and reimbursements for universal personal telecommunication"
* Recommendation ITU-T E.168 "Application of E.164 numbering plan for UPT"
* Recommendation ITU-T E.168.1 "Assignment procedures for universal personal telecommunications (UPT) numbers in the provisioning of the international UPT service"
* Recommendation ITU-T E.174 "Routing principles and guidance for Universal Personal Telecommunications (UPT)"
* Recommendation ITU-T E.755 "Reference connections for UPT traffic performance and GOS"
* Recommendation ITU-T E.775 "UPT grade of service concept"
* Recommendation ITU-T E.776 "Network grade of service parameters for UPT"
* Recommendation ITU-T F.850 "Principles of Universal Personal Telecommunication (UPT)"
* Recommendation ITU-T F.851 "Universal Personal Telecommunication (UPT) – Service description (service set 1)"
* Recommendation ITU-T F.852 "Universal Personal Telecommunication (UPT) – Service description (service set 2)"
* Recommendation ITU-T F.853 "Supplementary services in the Universal Personal Telecommunication (UPT) environment"
* Recommendation ITU-T Q.1521 "Requirements on underlying networks and signalling protocols to support UPT"
* Recommendation ITU-T Q.1531 "UPT security requirements for Service Set 1"
* Recommendation ITU-T Q.1541 "UPT stage 2 for Service Set 1 on IN CS-1 – Procedures for universal personal telecommunication: Functional modelling and information flows"
* Recommendation ITU-T Q.1542 "UPT stage 2 for Service Set 1 on IN CS-2 – Procedures for universal personal telecommunication: Functional modelling and information flows"
* Recommendation ITU-T Q.1551 "Application of Intelligent Network Application Protocols (INAP) CS-1 for UPT service set 1"

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

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

TSB continues to collect all new terms and definitions proposed by ITU-T SGs, entering them into the online [ITU Terms and Definitions database](https://www.itu.int/br_tsb_terms/#/).

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

TSB also translated eight Recommendations approved under the Alternative Approval Process in the reporting period, in accordance with requests received from ITU-T SGs and linguistic groups, and within the available budget.

# 15 Services and tools

TSB continuously develops new applications using, where applicable, open-source and machine learning solutions, in addition to the ITU infrastructure services, while enhancing existing applications, to expand further its ongoing digital transformation.

## 15.1 ITU-T activities and the SDGs

The "[AI-based mapping of ITU activities to UN-SDGs](https://aisdg.itu.int/)" maps ITU work to the SDGs according to semantic relevance. Developed by TSB, the solution continues to be improved with the support of feedback from ITU members and staff. The mapping is accessible in [MyWorkspace](https://www.itu.int/myworkspace/#/sdg) with ITU User Account (TIES) credentials. The solution has been applied to the work of ITU-T and ITU-D.

## 15.2 ITU-T applications

The following applications are made available for ITU-T delegates and secretariat staff:

* [Work Programme](http://www.itu.int/ITU-T/workprog), [Recommendations](http://www.itu.int/itu-t/recommendations), [IPR](https://www.itu.int/net4/ipr/search.aspx?sector=ITU&class=PS)  & [Liaison Statements](https://www.itu.int/net4/itu-t/ls)
* Publications Editing, Events Organization & Public Relations materials Workflows
* [Alternative Approval Process](https://www.itu.int/t/aap/about-aap): Online management tool
* [ICT standards landscape](https://www.itu.int/net4/ITU-T/landscape): Online ICT standards collaboration tool
* TSB Reporting: Microsoft Power BI Management Dashboard
* [MyWorkspace](http://www.itu.int/myworkspace): ITU-T Members’ workspace portal
* [Translate](https://www.itu.int/myworkspace/#/Translate): Open-source machine translation for Word file
* [Documents](https://www.itu.int/myworkspace/#/Documents/MyDocuments): Open-source search engine & machine translation for meeting documents
* [MyMeetings](https://www.itu.int/myworkspace/#/E-meetings): Open-source solution for ITU-T fully virtual meetings or physical with remote participation meetings
* [TSBCloud](https://tsbcloud.itu.int/nextcloud/login): Open-source ITU on-premises storage service allowing users to share and exchange up to 10 GB of files per user.

## 15.3 ITU-wide applications

The following ITU-wide applications are available:

* [ITU Search](https://www.itu.int/search): Open-source search engine on all ITU digital resources
* [ITU Conformity & Interoperability](https://www.itu.int/en/ITU-T/C-I/Pages/default.aspx): ICT products conformity and testing labs registry
* [International Numbering Resources](https://www.itu.int/en/ITU-T/inr/Pages/default.aspx): Online access to INRs
* [National Numbering Plans](https://www.itu.int/itu-t/nnp/#/home): Online repository of NNPs
* [Terminology](https://www.itu.int/br_tsb_terms/#/): Online ITU-R / ITU-T terms & definitions search

## 15.4 ITU-T services

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

## 15.5 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 ITU-T Study Groups 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 FAQ 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).

## 15.6 ITU-T SharePoint collaboration sites

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

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

A selection of notable collaboration sites is listed below:

* ITU-T Study Groups (Study Period 2022-2024) (<https://extranet.itu.int/sites/itu-t/studygroups/2022-2024/SitePages/Home.aspx>)
* 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/>)
* Joint IEC-ISO-ITU Smart Cities Task Force (<https://extranet.itu.int/sites/itu-t/initiatives/J-SCTF/>)
* Joint Coordination Activities (<https://extranet.itu.int/sites/itu-t/jca/>)
* Joint Groups with other SDOs (<https://extranet.itu.int/sites/itu-t/jointgroups/>)
* Intersector Rapporteur Groups (<https://extranet.itu.int/sites/irg/>)
* FG-AI4AD – ITU-T Focus Group on Autonomous and Assisted Driving (<https://extranet.itu.int/sites/itu-t/focusgroups/ai4ad>)
* FG-AI4EE – Focus Group on Environmental Efficiency for AI and other Emerging Technologies  
  (<https://extranet.itu.int/sites/itu-t/focusgroups/ai4ee/>)
* FG-AI4H – ITU-T Focus Group on AI for Health (<https://extranet.itu.int/sites/itu-t/focusgroups/ai4h/>)
* FG-AN – ITU-T Focus Group on Autonomous Networks (<https://extranet.itu.int/sites/itu-t/focusgroups/an/SitePages/Home.aspx>)
* FG-AI4NDM – ITU-T Focus Group on Artificial Intelligence for Natural Disaster Management (<https://extranet.itu.int/sites/itu-t/focusgroups/ai4ndm/SitePages/Home.aspx>)
* FG-QIT4N – ITU-T Focus Group on Quantum Information Technology for Networks (<https://extranet.itu.int/sites/itu-t/focusgroups/qit4n>)
* FG-VM – ITU-T Focus Group on Vehicular Multimedia  
  (<https://extranet.itu.int/sites/itu-t/focusgroups/vm/>)
* FG-TBFxG - ITU-T Focus Group on Testbeds Federations for IMT-2000 and beyond – (<https://extranet.itu.int/sites/itu-t/focusgroups/tbfxg>)
* CASC – ITU-T Conformity Assessment Steering Committee  
  (<https://extranet.itu.int/sites/itu-t/studygroups/2017-2020/sg11/casc/>)
* Pathway #1: Circular Design (<https://extranet.itu.int/sites/itu-t/initiatives/circulardesign>)
* Digital Currency Global Initiative (<https://extranet.itu.int/sites/itu-t/initiatives/dcgi>)
* Project on E-waste (<https://extranet.itu.int/sites/itu-t/initiatives/E-waste>)
* Focal points and coordinators for WTSA-20 from regional organizations (<https://extranet.itu.int/sites/itu-t/wtsa-20/prepmeet/Lists/ContactSheet/DefViewContacts.aspx>)
* [Numbering Applications Monitor](https://extranet.itu.int/sites/itu-t/studygroups/2017-2020/sg2/SitePages/Numbering%20Applications%20Monitor.aspx)

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

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

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# Appendix I – List of approved texts and texts undergoing approval

NOTE – Corrigenda are not listed here.

I.1.1 Ultra-high-speed optical access

[**ITU-T G.987.2 (revised) “10-Gigabit-capable passive optical networks (XG-PON): Physical media dependent (PMD) layer specification”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=15124) adds a new Annex specifying out of band noise limits on XG-PON ONUs to reduce the impact on other systems coexisting on the same PON.

**ITU-T G.987.2 Amd.1 “10-Gigabit-capable passive optical networks (XG-PON): Physical media dependent (PMD) layer specification - Amendment 1” (under approval)** adds a new Annex specifying out of band noise limits on XG-PON ONUs to reduce the impact on other systems coexisting on the same PON.

**ITU-T G.989.3 Amd.1 “40-Gigabit-capable passive optical networks (NG-PON2): Transmission convergence layer specification” (under approval)** incorporates regular maintenance items, supplying new Appendix XI describing the behaviour of an NG-PON2 ONU in the Emergency Stop state, introducing the deactivation reason code reported downstream for offline troubleshooting purposes, and fixing the inconsistency in handling of the Forgotten ONU timer TO6.

[**ITU-T G.9802.1 Amd.1 (revised) “Wavelength division multiplexed passive optical networks (WDM PON): General requirements - Amendment 1”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=15158) adds requirements on failure protection for CT, ODN or both in wavelength routed PONs.

**ITU-T G.9802.2 “Wavelength division multiplexed passive optical networks (WDM PON): physical media dependent (PMD) layer and transmission convergence (TC) layer specification” (under approval)** describes a Wavelength Routed Optical Distribution Network (WR-ODN) based Wavelength Division Multiplexed Passive Optical Network (WDM PON). This Recommendation, as part of the multi-wavelength passive optical network (MW-PON) G.9802 series Recommendation, specifies a PON system utilising a wavelength multiplexer in the Optical Distribution Network (ODN). The specifications of both the physical media dependent (PMD) and transmission convergence (TC) layers of WR-ODN based WDM PON are captured in this Recommendation. The PMD layer specification includes aspects such as the reference logical architecture, wavelength plan, optical path loss, transmitter and receiver specifications, compatible ODN, etc. The TC layer specification includes the details of the Forward Error Correction (FEC) code, implementation methods of the management channel, management functions, a set of processes and messages, etc. to provide similar operation experience as legacy PON systems, e.g., silent start and capability to map a local Physical Layer Operation, Administration and Maintenance (PLOAM) channel.

[**ITU-T G.9804.2 Amd.1 “Higher Speed Passive Optical Networks - Common Transmission Convergence Layer Specification - Amendment 1”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=14645) includes the dedicated activation wavelength definition in Clause 3, a description on the processing sequence of the PSBd generation, FEC encoding, and scrambling in Clauses 6 and 10, collision resolution condition update in clause 7, the definition of optional upstream FEC codes and associated messages in clauses 10 and 11 and in Annex B, Burst\_Profile PLOAM message modifications in clause 11, Assign\_ONU-ID/Collision\_Feedback PLOAM message name update in clause 11, golden vectors in Appendix IV, and typo corrections.

[**ITU-T G.9804.3 Amd.1 “50-Gigabit-capable passive optical networks (50G-PON): Physical media dependent (PMD) layer specification Amendment 1”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=15160) describes a 50-Gigabit-capable passive optical network (50G PON) system in an optical access network for residential, business, mobile backhaul and other applications. This system operates over a point-to-multipoint optical access infrastructure at the nominal line rate of 50 Gbit/s in the downstream direction. In the upstream direction, 12.5 Gbit/s, 25 Gbit/s and 50 Gbit/s nominal line rates are defined. This Recommendation contains the references, the common definitions, acronyms, abbreviations and the specifications of the physical media dependent layer of the 50G-PON system. Amendment 1 defines a third upstream wavelength “option 3” to support triple WDM coexistence with both GPON and XG(S)-PON, optical interface parameters of 50 Gbit/s upstream direction, optical interface parameters for non-MPM use cases, and the ONU out-of-band power spectral density requirements.

**ITU-T G.9805 Amd.1 “Coexistence of Passive Optical Network Systems -Amendment 1” (under approval)** includes additional 3-gen PON systems coexistence methods, and Crosstalk analysis between PON systems.

**ITU-T G.9806 Amd.3 “Higher speed bidirectional, single fibre, point-to-point optical access system (HS-PtP)- Amendment 3” (under approval)** adds support for 100 Gbit/s, Optical Path Loss budget Class S (0-15 dB).

[**ITU-T G.9807.1 (revised) “10-Gigabit-capable symmetric passive optical network (XGS-PON)”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=15133) adds an Annex specifying out of band noise limits on XGS-PON ONUs to reduce the impact on other systems coexisting on the same ODN.

I.1.2 Optical fibres

**ITU-T L.340 (revised) “Maintenance of telecommunication underground facilities” (under approval)**: Underground facilities such as tunnels, maintenance holes and handholes are deteriorating continuously as time go by. For example, cracks and water leakages occur and these phenomena degrade the safety and serviceability of the underground facilities. If the deterioration is neglected, large-scale repair and reinforcement measures may be required, which will further increase the cost in the future. Therefore, it is highly recommended that periodic inspection and timely maintenance are performed. Safety management of telecommunication infrastructure facilities is generally described in ITU-T Recommendation L.330, but the detailed technologies and countermeasures for each facility are left for other Recommendations. This Recommendation describes the inspection procedures, technologies and countermeasures for maintenance of underground facilities defined in L.330.

I.1.3 Optical transport network (OTN)

**ITU-T G.698.1 (revised) “Multichannel DWDM applications with single-channel optical interfaces” (under approval)** provides optical parameter values for physical layer interfaces of dense wavelength division multiplexing (DWDM) systems primarily intended for metro applications. Applications are defined using optical interface parameters at the single-channel connection points between optical transmitters and the optical multiplexer, as well as between optical receivers and the optical demultiplexer in the DWDM system. This Recommendation uses a methodology which fixes the maximum attenuation of the multiplexer/demultiplexer and fibre together and, therefore, does not specify the maximum fibre-link length explicitly. This Recommendation includes unidirectional DWDM applications at 2.5 and 10 Gbit/s with 100 GHz channel frequency spacing, as well as applications at 10 Gbit/s with 50 GHz channel frequency spacing. This latest revision of Recommendation ITU-T G.698.1 includes DWDM applications at 25 Gbit/s with 100 GHz channel frequency spacing.

**ITU-T G.698.4 (revised) “Multichannel bi-directional DWDM applications with port agnostic single-channel optical interfaces” (under approval)** provides optical parameter values for physical layer interfaces of dense wavelength division multiplexing (DWDM) systems primarily intended for metro applications, where the tail-end transmitters have the capability to automatically adapt their DWDM channel frequency to the optical demultiplexer/optical multiplexer (OD/OM) or optical add-drop multiplexer (OADM) port. Applications are defined using optical interface parameters and values for single-channel and multichannel interfaces of multichannel DWDM optical systems in point-to-point applications. This Recommendation uses a system architecture comprising a head-end, connecting to the tail-end equipment (TEE) through a black link. The head end houses a set of transmitters and receivers and an OD/OM. A single bidirectional fibre is used to connect the head-end to the black link OD/OM or OADM. The connection between the OD/OM/OADM and the TEE is also bidirectional. This version of the Recommendation includes DWDM applications at 10 Gbit/s and 25 Gbit/s with minimum channel frequency spacing of 50 GHz and 100 GHz, respectively.

**ITU-T G.709.1/Y.1331.1 Amd.4 “Flexible OTN short-reach interfaces - Amendment 4” (under approval)** adds definitions for FlexO frames using 800 Gb/s physical interfaces, including mapping of Ethernet directly to FlexO (without defining an associated FEC frame), modifications related to 100 Gb/s per lane signalling for FlexO-1 and FlexO-4, (i.e., FOIC1.1, FOIC4.4), editorial clarifications related to renaming Pad overhead as Extended overhead, reorganization of the FlexO frame description to enable potential use of different types of FEC frames for beyond 400G interfaces, and additional overhead to support new FlexO applications.

**ITU-T G.798 (revised) “Characteristics of optical transport network hierarchy equipment functional blocks” (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. Edition 7.0 of this Recommendation includes the text of Amendments 1, 2, 3 and 4, as well as Corrigenda 1 and 2 to Edition 6.0 of this Recommendation, the addition of the ODUkP to ETH adaptation function using Idle Mapping Procedure (IMP) and a number of editorial enhancements.

**ITU-T G.Suppl. 58 (revised) “Optical transport network module framer interfaces” (under approval)** describes several interoperable component-to-component multilane interfaces (across different vendors) to connect an optical module (with or without digital signal processor) to a framer device in a vendor's equipment supporting 25G, 40G, 50G, 100G or beyond 100G optical transport network (OTN) interfaces. Only the structure of the 11G, 28G, 56G, or 112G physical lanes of the different OTN module framer interface examples is provided in this Supplement. Electrical parameters for these interfaces can use specifications provided in the relevant clauses of Optical Internetworking Forum common electrical input/output (OIF-CEI) implementation agreement (IA) specifications. For their electrical characteristics, the OIF-CEI IA specifications can be used. This Supplement relates to Recommendation ITU-T G.709/Y.1331.

I.1.4 Ethernet over transport networks

**ITU-T G.8013/Y.1731 (revised) “Operation, administration and maintenance (OAM) functions and mechanisms for Ethernet-based networks” (under approval)** provides mechanisms for user-plane OAM functionality in Ethernet networks according to the requirements and principles given in Recommendation ITU T Y.1730. This Recommendation is designed specifically to support point-to-point connections and multipoint connectivity in the ETH layer as identified in Recommendation ITU T G.8010/Y.1306. The OAM mechanisms defined in this Recommendation offer capabilities to operate and maintain network and service aspects of the ETH layer.

**ITU-T G.8051 Amd.1 “Management aspects of the Ethernet transport (ET) capable network element - Amendment 1” (under approval)** has updated the Fault cause persistency function; Alarm reporting control function; Operational state function in clause 7; the provisioning and reporting for flow termination and adaptation functions in clause 8 in alignment with ITU-T G.8021 and G.8023. Also this amendment created clause 8.14 "Administrative state” in alignment with G.7710.

[**ITU-T G.8052.1/Y.1346.1 Amd.1 (revised) “Operation, administration, maintenance (OAM) management information and data models for the Ethernet-transport network element - Amendment 1”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=15148) updates the UML model to support on-demand measurement and proactive measurement.

I.1.5 Synchronization and timing

**ITU-T G.8271.1/Y.1366.1 Amd.1 “Network limits for time synchronization in packet networks with full timing support from the network - Amendment 1” (under approval)** provides the following updates:

• Clarifications and improvements in clause XI, Measurement of maximum relative time error limits.

• Editorial changes replacing the term calibration with compensation that better reflect what is meant throughout this document.

• Enhanced network limits at reference point C have been added as clause 7.3.3, then for clarity old clause 7.3 text is moved into new clause 7.3.1 and old clause 7.5 is moved to new clause 7.3.2.

• Change non-inclusive language in line with IEEE1588g.

**ITU-T G.8273/Y.1368 (revised) “Framework of phase and time clocks” (under approval)** is a framework Recommendation for phase and time clocks for devices used in synchronizing network equipment that operate in the network architecture defined in Recommendations ITU-T G.8271, ITU-T G.8275 and the ITU-T G.8271.x series of Recommendations.

**ITU-T G.8273.2/Y.1368.2 (revised) “Timing characteristics of telecom boundary clocks and telecom time synchronous clocks for use with full timing support from the network” (under approval)** specifies minimum requirements for time and phase for telecom boundary clocks and telecom time synchronous 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.

I.2.1 Smart ubiquitous networks, next-generation networks evolution, and future networks

**ITU-T Y.2073 “Framework of trusted electricity brokerage for distributed energy resources” (under approval):** Due to the rapid spread of distributed energy resources, the demand for intermediary trading (i.e., brokerage) of surplus electricity for energy prosumers in electricity markets is significantly increasing. To support transparency of brokerage transactions in the trading process, various technologies such as blockchain can be applied to applications that require mutual trust between users in a trustless environment. Thus, this Recommendation provides a framework of trusted electricity brokerage for distributed energy resources taking into account the blockchain technology for trust provisioning in electricity markets. After introducing key characteristics, core technologies and service scenarios for trusted electricity brokerage with the necessity of the blockchain technology to ensure trust, this draft Recommendation mainly presents requirements, architecture overview specifying related interfaces and functional blocks for the blockchain enabled trusted electricity brokerage.

[**ITU-T Y.2248 “Service model for entry-level smart farm”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=15232)**:** Entry-level smart farms can provide convenience of use and increased economic profits to agricultural producers that have not been familiar with high-level ICT technologies. This Recommendation describes the service model for entry-level smart farm. The scope of this Recommendation covers reference architecture, service requirements and service scenarios for the entry-level smart farm.

[**ITU-T Y.3119 “Future networks including IMT-2020: capability classification framework for dedicated networks”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=15233)**:** In the context of future networks including IMT-2020, dedicated networks are networks designed for application domains with common requirements. The capabilities of dedicated networks include, but are not limited to, core network, transport network, access network, service support, management, infrastructure, and artificial intelligence (AI)/machine learning (ML) enabling capabilities. To evaluate the capabilities of dedicated networks in a standardized way, there exists the need to introduce capability classification for dedicated networks. With the understanding that the capability level is the level of availability of capabilities in a network, the capability classification is based on the evaluation of the capability level of the network. This Recommendation specifies the methods and framework of capability classification for dedicated networks.

[**ITU-T Y.3120 “Functional Architecture for latency guarantee in large scale networks including IMT-2020 and beyond”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=15234) specifies the functional architecture, functional entities, reference points, and operational procedures, for the requirements and framework defined in Y.3113, based on the architecture defined in Y.2111. Meanwhile, Y.3113 specifies the use of flow aggregate (FA)-based scheduling and regulators at aggregation domain (AD) boundaries. Y.2111 specifies the resource and admission control functions (RACF) in support of end-to-end quality of service (QoS) and necessary transport functions in next generation networks (NGNs).

**ITU-T Y.3184 “Mechanism for intelligent awareness of network status” (under approval)** specifies mechanism for intelligent awareness of network status. The scope of this Recommendation includes: introduction of intelligent awareness of network status; overview of mechanism for intelligent awareness of network status; mechanism for intelligent awareness of network fault; mechanism for intelligent awareness of network performance; mechanism for intelligent awareness of network resource; mechanism for intelligent awareness of network load; mechanism for intelligent awareness of other aspects of network status and security consideration.

**ITU-T Y.3540 “Edge computing - Overview and highlevel requirements” (under approval)** provides overview and high-level requirements of edge computing. This Recommendation defines terms related to the edge computing, describes overview of edge computing including concept, common characteristics, ecosystem with operations by edge computing main roles. Also, this Recommendation provides orchestration aspects for edge computing and relationship with other technologies. This Recommendation provides high-level requirements through various use cases.

I.2.2 IMT-2020/5G networks

[**ITU-T F.743.18 “Requirements for IMT-2020 ultra-high definition surveillance camera”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=15185) defines typical use cases, functional requirements, performance requirements and security requirements for IMT-2020 UHD surveillance cameras, in order to solve UHD video reliably transmission in IMT-2020. This Recommendation also defines the classification of IMT-2020 UHD surveillance service, SLA rank of IMT-2020 UHD surveillance service, the network requirements for IMT-2020 UHD video surveillance service which are very relevant to IMT-2020 surveillance scenarios, so as to meet the actual user’s UHD video captured and transmission requirements.

[**ITU-T L.1390 “Energy saving technologies and best practices for 5G RAN equipment”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=15029)**:** With the rapid development and commercialization of 5G radio communication technology, the 5G network construction is further accelerated. While being an important enabler for digitalization of other industries and thereby contribute to significant energy savings and emission reductions, it is also important to consider the energy consumption of the 5G network infrastructure itself. This Recommendation identifies energy saving potentials, describes energy-saving principles and technologies for 5G RAN and related equipment, and provides best practice recommendations when and how these technologies should be used and controlled thereby reducing the 5G RAN energy consumption, saving operational costs, and making the 5G RAN a green and high-efficiency network.

[**ITU-T Q.5004 “Signalling architecture of Lite IMS for IMT-2020 network and beyond”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=15256): In the context of signalling architecture of LiteIMS for IMS-2020 network and beyond, the signalling architecture is designed for IMS domain with high efficiency, extensibility, intelligence and high value-added characteristics.

[**ITU-T Q.5005 “Requirement, framework and protocols for signalling network analysis and optimization in IMT-2020”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=15257) specifies the framework, interfaces and protocols, and service procedures for signalling network analysis and optimization in IMT-2020, in which the signalling network refers to the network functions and the signalling exchange which are related to telecommunications services. It covers the aspects including an overview of a signalling network, requirements for signalling collection, requirements for signalling network analysis, requirements for signalling network optimization, framework, interfaces and protocols, service procedures, AI-assisted functions and general security considerations of signalling network analysis and optimization in IMT-2020.

[**ITU-T X.1815 “Security guidelines and requirements for IMT-2020 edge computing services”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=15113): The IMT-2020 network will enable a variety of services, including enhanced mobile broadband (eMBB) services, massive machine type communications (mMTC) based services and ultrareliable low latency communications (URLLC) based services, on an infrastructure of network and computing resources. In line with the key features and the requirements identified for the IMT-2020 network, it is required to be more efficient, personalized, intelligent, reliable and flexible. To support the typical services in the IMT-2020 network, especially eMBB services and URLLC based services, edge computing is acknowledged to be one of the key technologies for meeting the demanding key performance indicators (KPIs) of the IMT-2020 network, especially as far as low latency and bandwidth efficiency are concerned. Edge computing enables the operator and the third party service provider to deploy the services close to the user's access point, thus achieving high-efficiency service delivery through reduced end-to-end latency and load on the transport network. In order to ensure the security of edge computing service deployment and application, the security threats and relevant security requirements specific to edge computing service need to be analysed and the overall security framework need to be established. This Recommendation aims to analyses the deployment scheme and typical application scenarios of edge computing services, specifies the security threats and requirements specific to edge computing services in IMT-2020 and thus establishes security capabilities for the operator to safeguard its applications.

[**ITU-T X.1816 “Guidelines and requirements for classifying security capabilities in IMT-2020 network slice”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=15114): The definition of basic network slicing technology functions and processes has laid a solid foundation for the first wave of IMT-2020 deployment and commercial use of network slicing services. As an end-to-end logical network that is customized on demand, slicing can provide differentiation security capabilities: First, the IMT-2020 network slicing provides the supporting security measures for the differentiated network implementation. Second, the IMT-2020 network supports some optional security measures at the slice level. Some security measures can also provide multiple security options and operators may own different security resources. These may bring different degrees of security guarantee or non-security performance. Slice customers also have specific security requirements and may request customized network slices with different security protection levels from slice operators. There exist some challenges for the slice customers or the slice operators choosing the security capabilities of their slices such as management cost and definition inconsistency, etc. The objective of this Recommendation is to provide a description of differentiated IMT-2020 network slice security capabilities and guideline for classifying the IMT-2020 network slice security capabilities and IMT-2020 network slice security to help the ecosystem more clearly understand and choose the slicing security capabilities.

**ITU-T X.1817 “Security requirements for 5G message service” (under approval)** provides the security requirements for 5G messaging service, including use security requirements, management security requirements and control security requirements for 5G messaging service.

[**ITU-T Y.3121 “QoS requirements and framework for supporting deterministic communication services in local area network for IMT-2020”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=15235) specifies QoS requirements and framework for supporting deterministic communication services in a local area network (LAN). First, it presents the concept and benefits of deterministic communication services in a LAN consisting of heterogeneous network technologies. Then it specifies a high-level model and associated QoS requirements for inter- technology domain deterministic communication services in LAN. Based on the identified QoS requirements, it identifies a framework and an example operational procedure. Finally, it provides three scenarios and associated use cases as informal material in appendixes.

[**ITU-T Y.3122 “Quality of service assurance requirements and framework for smart grid supported by IMT-2020 and beyond”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=15531) specifies the quality of service (QoS) assurance aspects for the smart grid supported by the international mobile telecommunications 2020 (IMT-2020) and beyond. It first provides an overview of the smart grid supported by IMT2020 and beyond. It then identifies a number of QoS considerations. The QoS assurance requirements and framework based on the QoS considerations are specified. Finally, smart grid application scenarios with detailed QoS requirements supported by IMT2020 and beyond are described in appendix I.

**ITU-T Y.3123 “Framework of edge computing capability exposure for IMT-2020” (under approval)**: There are various edge computing capabilities that can be exposed to applications. With the exposure of such capabilities, the applications, including edge computing applications and non-edge computing applications, are able to obtain augmented information from which these applications can benefit, especially, but not limited to, in terms of performance. This Recommendation specifies the framework of edge computing capability exposure for IMT-2020 networks and beyond.

**ITU-T Y.3159 “Framework for classifying network slice level in future networks including IMT-2020” (under approval)** specifies a framework for classifying network slice level in future networks including IMT-2020. This framework guides the network slice deployment and management. A method for classifying network slice level of future networks including IMT-2020 is introduced.

[**ITU-T Y.3160 “Architectural framework of end-to-end service level objective guarantee for future networks”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=15533) describes the architectural framework of end-to-end service level objective guarantee for future networks including IMT-2020, which considers the following issues:

- Overview of SLO guarantee;

- A mechanism for SLO guarantee;

- The SLO design and acceptance method.

[**ITU-T Y.3202 “Fixed, mobile and satellite convergence - Mobility management for IMT-2020 networks and beyond”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=15535): Fixed, mobile and satellite convergence (FMSC) is the capability that provides services and applications to end users regardless of the fixed, mobile, or satellite access technologies. This Recommendation specifies the mobility management requirements, architecture, procedures, and security considerations for FMSC in IMT-2020 networks and beyond.

[**ITU-T Y.3203 “Fixed, mobile and satellite convergence - Connection management for IMT-2020 networks and beyond”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=15536) specifies the framework and functions of connection management for fixed, mobile and satellite convergence (FMSC) in IMT-2020 networks and beyond. The Recommendation specifies connection status management, control plane functions and user plane functions maintenance in connection scenarios involving FMSC network.

[**ITU-T Y.3201 “Fixed, mobile and satellite convergence – Framework for IMT-2020 networks and beyond”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=15239)**:** Fixed, mobile and satellite convergence (FMSC) is the capability that provides services and applications to end users regardless of the fixed, mobile or satellite access technologies. This Recommendation specifies the design considerations, framework, enabling technologies, network function enhancements, procedures, and security considerations of FMSC, in the context of IMT-2020 networks and beyond.

[**ITU-T Y.Suppl.59 (revised) to ITU-T Y.3100 of Recommendations “IMT-2020 standardization roadmap”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=15248) provides the standardization roadmap for IMT-2020 area in the telecommunication sector. It addresses the following subjects:

• The collection/pointers to the standards and publications of IMT-2020 deliverables in ITU T study groups (SGs) and other standards development organisations (SDOs);

• Responsible group (owner);

• Status;

• Subject;

• Topics.

I.2.3 Home networking

**ITU-T G.9901 Amd.1 “Narrowband orthogonal frequency division multiplexing power line communication transceivers – Power spectral density specification – Amendment 1” (under publication)** introduces FCC-Low and FCC-High bandplans in Annex B.

[**ITU-T G.9903 Amd.2 “Narrowband orthogonal frequency division multiplexing power line communication transceivers for G3-PLC networks”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=15162) covers Cenelec A, Cenelec B, ARIB and FCC bandplans. It adds new mechanisms to improve efficiency of broadcast transmissions (for both data traffic and LOADng RREQ routing messages) and extends the G3-PLC Hybrid PLC & RF Profile with new operating frequency bands, an RF transmit power adaptation mechanism, frequency hopping and a last gasp feature (consisting in an alerting mechanism in case a power outage is experienced by a device in the network).

**ITU-T G.9940 “High speed fibre-based in-premises transceivers - system architecture” (under approval)** belongs to the family of ITU-T G.9940 Recommendations. Recommendation ITU-T G.9940 specifies the system architecture and requirements for high-speed fibre-based in-premises transceivers.

**ITU-T G.9960 (revised) “Unified high-speed wireline-based home networking transceivers – System architecture and physical layer specification” (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. This revision comprises ITU-T G.9960 (2018) plus its Corrigendum 1, Amendment 1, Amendment 2, Corrigendum 2, and Amendment 3, along with the specification of a new PHY frame type for use by ITU-T G.9991.

**ITU-T G.9961 (revised) “Unified high-speed wireline-based home networking transceivers – Data link layer specification” (under approval)**: Recommendation ITU-T G.9961 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. This revision comprises ITU-T G.9961 (2018) plus its Amendments 1, 2 and 3, and Corrigenda 1 and 2, along with a new Annex B on authentication to a domain using external authentication for smart grid applications.

**ITU-T G.9962 (revised) “Unified high-speed wire-line based home networking transceivers - Management Specification” (under publication)** includes the specifies the physical and data link layer management for the ITU T G.996x series home networking transceiver specifications. It defines common management parameters and protocols for all ITU-T G.996x-series Recommendations for the purpose of device configuration, status and performance management, fault monitoring and diagnostics. It also provides management functionalities to coordinate multiple domains. It includes support for LCMP communication through the L1 and L6 interfaces and some associated data models.

**ITU-T G.9963 (revised) “Unified high-speed wireline-based home networking transceivers – Multiple input/multiple output specification (2023)” (under approval)** belongs to the family of ITU-T G.996x Recommendations. Recommendation ITU-T G.9963 specifies the additions and modifications to Recommendations ITU T G.9960 and ITU-T G.9961 that are needed for a multiple input multiple output (MIMO) home networking transceiver capable of operating over premises power-line wiring. MIMO transceivers are able to transmit and receive over three power-line conductors (phase, neutral and ground). This Recommendation also specifies the means by which transceivers that comply with ITU-T G.9960, ITU T G.9961 and ITU-T G.9963 interoperate when used on the same wires.

**ITU-T G.9964 (revised) “Unified high-speed wireline-based home networking transceivers – Power spectral density specification” (under approval)** specifies the control parameters that determine spectral content, power spectral density (PSD) mask requirements, a set of tools to support reduction of the transmit PSD, means to measure this PSD for transmission over telephone wiring, power line wiring and coaxial cable, as well as the allowable total transmit power into a specified termination impedance. It complements the system architecture and physical layer (PHY) specification in Recommendation ITU-T G.9960, and the data link layer (DLL) specification in Recommendation ITU-T G.9961, as well as the modifications and additions to these Recommendations specifying the multiple input/multiple output (MIMO) home networking transceiver in Recommendation ITU-T G.9963. This revision comprises ITU-T G.9964 (2011) plus its Amendments 1, 2 and 3, along with the addition of a narrower subcarrier spacing (12.20703125 kHz) for scenarios where the channel is very narrow (e.g., power line communication for smart grid applications).

I.2.4 Cloud computing and data handling

[**ITU-T F.746.14 “Requirements and reference framework for cloud virtual reality systems”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=15188)**:** Cloud virtual reality based on cloud capabilities, can effectively shield terminal differences, reduce the difficulty of application development, lower some specific industry entry barriers, and promote the industry business chain cooperation. This recommendation focuses on the overall requirements of cloud virtual reality systems and the related requirements of each layer including content requirements, network requirements, control requirements, resource requirements and terminal requirements, as well as the reference framework for related high-level functions.

[**ITU-T F.748.17 “Technical specification for artificial intelligence cloud platform: AI model development”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=15194) provides a framework for the cloud-based development of AI models. It covers the terminology, features, and reference design of an AI cloud platform to enable the development of AI models. It establishes the technical specifications of the platform's supporting functional modules, core functional modules, and auxiliary functional modules.

[**ITU-T X.1380 “Security guidelines for cloud-based data recorders in automotive environments”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=15106)**:** The purpose of this Recommendation is to standardize security guidelines for cloud-based data recorders in automotive environments. This Recommendation describes threats, vulnerabilities, security requirements, and use cases for cloud-based data recorders in automotive environments. Event data recorders are one of the most important components installed in automotive road vehicles in order to record vehicle status, vehicle movements and user inputs during crashes. Through analysing the event data, we can understand the cause of a crash and eventually use it to improve safety in automotive environments. A data storage system for automated driving is also an important component to record a set of data that will give a clear picture of the interactions between the driver and the automated driving system. However, conventional event data recorders record and manage the whole data locally, and in this way the data might come under threats of loss and destruction. Meanwhile, cloud computing is being considered an enabler of network access to a scalable and elastic pool of shareable physical or virtual resources with self-service provisioning and administration on-demand. Industries such as the aviation industry are already attempting to apply cloud services to event data recording systems to increase safety in the aviation environment. According to the current trend of connectivity among the vehicles, the event data recorders and the data storage system for automated driving in automotive will be implemented to increase their overall safety. However, They have various vulnerabilities in the process of collecting, transferring, storing, managing, and using the recorded data according to the distinctive characteristics of the automotive environment. Therefore, it is necessary to study these vulnerabilities, security requirements, and use cases for cloud-based data recorders in automotive environments.

[**ITU-T X.1644 “Security guidelines for distributed cloud”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=15112) analyses security threats and challenges on distributed cloud and propose security guidelines against threats for distributed cloud, which includes the security guidelines for core cloud, regional cloud and edge cloud.

**ITU-T X.1645 “Requirements of network security situational awareness platform for cloud computing” (under approval)**: Network security situational awareness (NSSA) is derived from “situational awareness”. It usually includes four processes: data acquisition, security situation analysis, security situation assessment and security situational tendency projection, and generally has the following capabilities: 1) the capability of detection and persistent monitoring various attack threats, abnormal behaviour and their scope of influence; 2) the capability of data mining, threat analysis, and the traceability of abnormal behaviour; 3) the capability of security prediction and early warning; 4) the capability of visualization of security situation. For cloud computing service providers, NSSA platform plays an important role in improving cloud computing's security protection, the ability to detect security breaches or anomalous behaviours, security decision-making and emergency response ability, and even it can help improve the early warning mechanism for cloud computing. This recommendation will first introduce the concept and development of network security situational awareness, analyze the advantages of NSSA coping with the security challenges of cloud computing, then aim to document the requirements for network security situational awareness platform for cloud computing.

**ITU-T Y.3527 “Cloud computing - End-to-end fault and performance management framework of network services in inter-cloud” (under approval)** provides framework and functional requirements of end-to-end(E2E) fault and performance management of network services (NSs) in inter-cloud. The functional requirements are derived from the corresponding typical use cases. In particular, a predictive model for fault and performance issues detection and localisation is presented.

[**ITU-T Y.3532 “Cloud computing - Functional requirements of Platform as a Service for cloud native applications”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=15537) provides overview and functional requirements of Platform as a Service (PaaS) for cloud native applications. To introduce cloud native PaaS, this Recommendation also provides an overview of cloud native and cloud native applications. This Recommendation also addresses functional requirements of PaaS for cloud native applications through various use cases.

[**ITU-T Y.3539 “Cloud computing - Framework of risk management”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=15241) provides framework of risk management in cloud computing environment, including risk assessment, risk treatment, risk acceptance, risk communication and consultation, and risk monitoring and review. It also provides a complete set of management processes and effective measures to reduce risks in cloud computing environments.

I.2.5 Big data

[**ITU-T Y.3603 (revised) “Big data - Requirements and conceptual model of metadata for data catalogue”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=15540) describes the general concept of metadata and its utilization in a big data ecosystem. Also, this Recommendation provides requirements and a conceptual model of metadata for the data catalogue as well as the extensible markup language (XML) schema of metadata as an example. This metadata supports finding data easier and is used for the exchange, preservation, integration and provenance of data in a big data ecosystem.

[**ITU-T Y.3607 “Big data – Functional architecture for data provenance”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=15242) describes a functional architecture for big data provenance. To provide the functional architecture for big data provenance, the big data provenance functions are defined based on the functional requirements and logical components identified in [ITU-T Y.3602]. This Recommendation also provides the relationship between the functional architecture of big data provenance and the big data reference architecture in [ITU-T Y.3605].

**ITU-T Y.3656 “Big data driven networking-mechanism of network service provisioning” (under approval):** The bDDN can provide a better integration and more intelligent capabilities, such as the capability of self-optimization, self-configuration, and intelligent fault management, based on big data plane and its machine learning capabilities. It can provide significantly enhancement to the network service provisioning by using big data intelligence. This recommendation specifies the network service provisioning mechanism in bDDN.

I.2.6 Network Management

**[ITU-T M.3020 (revised) “Management interface specification methodology”](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=15514)** describes the management interface specification methodology (MISM). It describes the process to derive interface specifications based on user requirements, analysis and design (RAD). Guidelines are given on RAD using unified modelling language (UML) notation; however, other interface specification techniques are not precluded. The guidelines for using UML are described at a high level in this ITU-T Recommendation.

[**ITU-T M.3366 “Requirements for management of blockchain system”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=15519) introduces requirements for management of blockchain system, includes configuration management, performance management, fault management and log management related to blockchain node, blockchain ledger, smart contract, consensus, account, etc., in blockchain system. This Recommendation proposes management requirements for private chains or permissioned chains.

[**ITU-T M.3367 “Requirements for robot-based on-site smart patrol of telecommunication network”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=15515) introduces requirements for IMR-based on-site smart patrol of telecommunication network, includes the network elements to be patrolled, requirements for management function of IMR-based patrol and related management interface.

[**ITU-T M.3383 “Requirements for log Analysis in telecom management with AI”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=15516)introduces requirements for log analysis in telecom management with AI, includes functional framework, functional requirements, and typical scenarios of log analysis in telecom management with AI. This Recommendation gives examples of some log types and characteristics. This Recommendation also describes use cases of log analysis in telecom management with AI.

[**ITU-T M.3384 “Intelligence Levels of AI enhanced Telecom Operation and Management (IL-AITOM)”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=15517) provides definitions, classifications, object selection and automatic evaluating mechanism, for evaluating the intelligence levels of systems which follow the framework of artificial intelligence enhanced telecom operation and management (AITOM) defined in [ITU-T M.3080].

[**ITU-T M.3385 “Intelligence Levels Evaluation Framework of AI enhanced Telecom Operation and Management”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=15518) provides detailed evaluation framework, evaluation rating method and automatic evaluating process for intelligence levels of systems which follow the framework of artificial intelligence enhanced telecom operation and management (AITOM).

I.2.7 Artificial Intelligence (AI), Machine Learning (ML)

[**ITU-T F.742.1 “Requirements for smart class based on artificial intelligence”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=15184) describes application scenarios and requirements for smart class system based on artificial intelligence, including application scenarios, service requirements, management requirements, and security considerations.

[**ITU-T F.746.16 “Technical requirements and evaluation methods of intelligent levels of intelligent customer service systems”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=15190): The intelligent customer service system can provide more convenient, efficient, and stable services for users through the application of AI technologies such as speech recognition, text to speech and natural language processing. Improving and evaluating the intelligence levels of the intelligent customer service system are valuable. This Recommendation specifies the requirements and evaluation methods for system intelligence of intelligence customer service system in four aspects, including the basic functions, the core technologies of AI, the maturation of system and the service experience.

[**ITU-T F.747.12 “Requirements for artificial intelligence based machine vision system in smart logistics warehouse”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=15193)**:** With the rapid development of industrial automation and logistics technology in accordance with the market demand for high-tech, machine vision technology has begun to enable the automation transformation of logistics warehouse systems. The application of machine vision technology in the field of logistics warehouse has enabled the rapid evolution of goods sorting, goods palletizing and de-palletizing, goods handling, and shelf inventory from intensive manual work to intelligence and automation, improving the operational efficiency and management capabilities of logistics warehouse. This Recommendation specifies the requirements and framework for artificial intelligence based machine vision system in smart logistics warehouse, and provides use cases. This Recommendation is intended to guide the design and development of machine vision systems in smart logistics warehouse.

[**ITU-T F.748.17 “Technical specification for artificial intelligence cloud platform: AI model development”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=15194) provides a framework for the cloud-based development of AI models. It covers the terminology, features, and reference design of an AI cloud platform to enable the development of AI models. It establishes the technical specifications of the platform's supporting functional modules, core functional modules, and auxiliary functional modules.

[**ITU-T F.748.18 “Metric and evaluation methods for AI-enabled multimedia application computing power benchmark”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=15195)**:** Facing more and more diverse AI computing systems, users hope to have a unified evaluation metric for the system that provides AI computing power. The establishment of relevant real application performance evaluation benchmarks can objectively reflect the current state of the AI computing ability by providing objective metrics and comparison dimensions. This Recommendation provides an AI computing power benchmark framework, evaluation metrics and methods, and a guideline for technical testing for AI clusters.

[**ITU-T F.748.19 “Framework for audio structuralizing based on deep neural network”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=15196) presents an overview of the framework for audio structuralizing based on deep neural network. It provides a high-level description of architecture, processing flows, data categories, audio processing tasks and requirements for data management.

[**ITU-T F.748.20 “Technical framework for deep neural network model partition and collaborative execution”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=15197)**:** Deep neural network (DNN) model inference process usually requires a large amount of computing resources and memory. Therefore, it is difficult for end devices to perform DNN models independently. It is an effective way to implement end-edge collaborative DNN execution through DNN model partition, which can reduce latency and improve resource utilization at the same time. This recommendation aims to specify the technical framework of DNN model partition and collaborative execution. First, it is necessary to predict the overall inference latency under the current system state according to different DNN partition strategies in advance. Then, choose the appropriate partition locations and collaborative execution strategy based on the equipment computation capabilities, network status and DNN model properties. Finally, implement the model collaborative execution and optimize the resource allocation in the meanwhile.

[**ITU-T F.748.21 “Requirements and framework for feature-based distributed intelligent systems”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=15198) introduces the use cases, classification of features and framework for feature-based distributed intelligent systems relevant to intelligent scenarios, specifying the service requirement, functional requirements, and security requirements for feature-based distributed intelligent systems.

[**ITU-T M.3367 “Requirements for robot-based on-site smart patrol of telecommunication network”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=15515) introduces requirements for IMR-based on-site smart patrol of telecommunication network, includes the network elements to be patrolled, requirements for management function of IMR-based patrol and related management interface.

[**ITU-T M.3383 “Requirements for log Analysis in telecom management with AI”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=15516)introduces requirements for log analysis in telecom management with AI, includes functional framework, functional requirements, and typical scenarios of log analysis in telecom management with AI. This Recommendation gives examples of some log types and characteristics. This Recommendation also describes use cases of log analysis in telecom management with AI.

[**ITU-T M.3384 “Intelligence Levels of AI enhanced Telecom Operation and Management (IL-AITOM)”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=15517) provides definitions, classifications, object selection and automatic evaluating mechanism, for evaluating the intelligence levels of systems which follow the framework of artificial intelligence enhanced telecom operation and management (AITOM) defined in [ITU-T M.3080].

[**ITU-T M.3385 “Intelligence Levels Evaluation Framework of AI enhanced Telecom Operation and Management”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=15518) provides detailed evaluation framework, evaluation rating method and automatic evaluating process for intelligence levels of systems which follow the framework of artificial intelligence enhanced telecom operation and management (AITOM).

[**ITU-T Y.3183 “Framework for network slicing management assisted by machine learning leveraging QoE feedback from verticals”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=15238) provides a framework for machine learning assisted network slicing management, leveraging vertical end users’ feedback on QoE, which can help achieve run-time optimisation of user perceived performance. The overall architecture, components, workflow and related APIs of this framework are specified with respect to the high-level requirements identified. A use case is provided in appendix to show an application example of this framework. Example implementations of the key APIs are also provided.

[**ITU-T Y.3325 “Framework for high-level AI-based management communicating with external management systems”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=15240)**:** After the IMT-2020 technology and network virtualization technology spread, the appearance of emerging services such as multimedia services (high resolution, AR, VR, etc.) and IoT will be expected. Since huge amount of traffic of these new coming services will be incurred to the network, the importance of the network flexibility and stability will increase. Network operators intend to improve network operations such as provisioning, resource control, failure detection and recovery, etc. Automatic network management supported by recent AI technologies, called AI-based network, will play an essential role for such era. On the other hand, service provider needs to manage service dynamically based on service and network status for better quality of service (QoS). In order for service providers to use the information managed by AI-based network effectively, common interface between system of service providers over AI-based network and AI-based network is required. This Recommendation describes requirements for reference model of such interactions including interface and metadata.

[**ITU-T Y.3814 “Quantum key distribution networks - functional requirements and architecture for machine learning enablement”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=15244)**:** QKDN is expected to maintain stable operations and meet the requirements of various cryptographic applications efficiently. Due to the advantages of machine learning (ML) related to autonomous learning, ML can help to overcome the challenges of QKDN in terms of quantum layer performances, key management layer performances and QKDN control and management efficiency. Based on the functional requirements and architecture of QKDN in [ITU-T Y.3801] and [ITU-T Y.3802], this recommendation is to specify one possible set of functional requirements and a possible architecture for ML-enabled QKDN (QKDNml), including the overview, the functional requirements, architecture and operational procedures of QKDNml.

**ITU-T Y.Sup.72 (revised) to Y.3000-series of Recommendations “Artificial Intelligence Standardization Roadmap”** **(under publication)** provides the standardization roadmap for artificial intelligence (AI) in the information and communication technologies area. This AI standardization roadmap has been developed to assist in the development of AI related standards in the ICT fields by providing information about existing and under developing standards in key standards development organizations (SDOs). In addition, it provides the overviews of AI and AI related technical areas from standards perspective, AI related activities in standards development organizations (SDOs), and gap analysis.

I.3.1 New services and applications

[**ITU-T F.742.1 “Requirements for smart class based on artificial intelligence”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=15184) describes application scenarios and requirements for smart class system based on artificial intelligence, including application scenarios, service requirements, management requirements, and security considerations.

[**ITU-T F.743.18 “Requirements for IMT-2020 ultra-high definition surveillance camera”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=15185) defines typical use cases, functional requirements, performance requirements and security requirements for IMT-2020 UHD surveillance cameras, in order to solve UHD video reliably transmission in IMT-2020. This Recommendation also defines the classification of IMT-2020 UHD surveillance service, SLA rank of IMT-2020 UHD surveillance service, the network requirements for IMT-2020 UHD video surveillance service which are very relevant to IMT-2020 surveillance scenarios, so as to meet the actual user’s UHD video captured and transmission requirements.

[**ITU-T F.743.19 “Requirements for intelligent surveillance camera in intelligent video surveillance systems”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=15186) specifies the intelligent analysis functions classification, intelligent analysis function scenarios, intelligent analysis function and grading requirements for intelligent surveillance camera. The related intelligent analysis functions include video diagnosis, tampering detection, video enhancement, target detection and feature extraction and object behaviours identification. The basic functions of a camera (see PU defined in [ITU-T H.626]) such as multimedia capturing, multimedia encoding, output alarm signal, parsing PTZ command, etc. are outside the scope of this Recommendation. This Recommendation defines the relevant intelligent analysis function and grading requirements for intelligent surveillance camera in IVS.

[**ITU-T F.743.22 “Requirements and architecture of algorithm training system for intelligent video surveillance”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=15187) specifies the requirements and architecture of the algorithm training system (ATS) for intelligent video surveillance (IVS) and provides the workflow of the algorithm training in the ATS. The intelligent analysis algorithm in IVS needs to train a large amount of actual scene data to improve the accuracy and the recall of identification. The ATS can collect video and image data from the IVS, complete sample data selection, data annotation, algorithm training, and deploy the algorithm into the IVS, so that the IVS has the reasoning capability of new scenarios, and the ATS can continuously iteratively improve on the algorithm identification performance. This Recommendation aims to solve the problems of difficult application of algorithm customization in various industries, long algorithm development and iteration cycle, and effective protection of user privacy and improvement of data security.

[**ITU-T F.746.14 “Requirements and reference framework for cloud virtual reality systems”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=15188)**:** Cloud virtual reality based on cloud capabilities, can effectively shield terminal differences, reduce the difficulty of application development, lower some specific industry entry barriers, and promote the industry business chain cooperation. This recommendation focuses on the overall requirements of cloud virtual reality systems and the related requirements of each layer including content requirements, network requirements, control requirements, resource requirements and terminal requirements, as well as the reference framework for related high-level functions.

[**ITU-T F.746.15 “Requirements for smart broadband network gateway in multimedia content transmission”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=15189) specifies requirements for smart broadband network gateway (BNG) in multimedia content transmission, which specifically describes the functional requirements and architecture, security requirements, typical application scenarios and use cases.

[**ITU-T F.746.16 “Technical requirements and evaluation methods of intelligent levels of intelligent customer service systems”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=15190): The intelligent customer service system can provide more convenient, efficient, and stable services for users through the application of AI technologies such as speech recognition, text to speech and natural language processing. Improving and evaluating the intelligence levels of the intelligent customer service system are valuable. This Recommendation specifies the requirements and evaluation methods for system intelligence of intelligence customer service system in four aspects, including the basic functions, the core technologies of AI, the maturation of system and the service experience.

[**ITU-T F.746.17 “Requirements for media processing services”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=15191) identifies the functional requirements for the media processing services. In particular, the scope of this Recommendation includes functional requirements and application scenarios. Media processing services utilize a set of techniques including cloud computing, computing resource virtualization, and job queue processing to dynamically control and manage computing resources, which improves scalability, flexibility, and availability. This Recommendation specifies the functional requirements of general requirements, service provision requirements, service management requirements, security considerations, etc.

[**ITU-T F.747.11 “Requirements for intelligent surface-defect detection service in industrial production line”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=15192): Intelligent surface-defect detection service in industrial production line refers to accurate positioning of products defects, high-speed classification of defects types, real-time output and transmission of visual and auditory information to ensure the quality of industrial products. Compared with the inspection carried out manually by workers, the ISD service can improve the efficiency and consistency and reduce manual operations in dangerous areas. This work item specifies requirements for intelligent surface-defect detection service in industrial production line, including performance requirements, application requirements and functional requirements. To provide effective surface-defect detection service, it is required to fulfil three important parts. Firstly, it is important to ensure the accuracy of positioning and classification. Secondly, the inference efficiency of the service is also required to satisfy the real-time settings. Last but not the least, the service is required to adapt to the typical application scenarios in industrial production line inspection task. This Recommendation provides related requirements for intelligent surface-defect detection service in industrial production line.

[**ITU-T F.747.12 “Requirements for artificial intelligence based machine vision system in smart logistics warehouse”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=15193)**:** With the rapid development of industrial automation and logistics technology in accordance with the market demand for high-tech, machine vision technology has begun to enable the automation transformation of logistics warehouse systems. The application of machine vision technology in the field of logistics warehouse has enabled the rapid evolution of goods sorting, goods palletizing and de-palletizing, goods handling, and shelf inventory from intensive manual work to intelligence and automation, improving the operational efficiency and management capabilities of logistics warehouse. This Recommendation specifies the requirements and framework for artificial intelligence based machine vision system in smart logistics warehouse, and provides use cases. This Recommendation is intended to guide the design and development of machine vision systems in smart logistics warehouse.

[**ITU-T F.748.17 “Technical specification for artificial intelligence cloud platform: AI model development”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=15194) provides a framework for the cloud-based development of AI models. It covers the terminology, features, and reference design of an AI cloud platform to enable the development of AI models. It establishes the technical specifications of the platform's supporting functional modules, core functional modules, and auxiliary functional modules.

[**ITU-T F.748.18 “Metric and evaluation methods for AI-enabled multimedia application computing power benchmark”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=15195)**:** Facing more and more diverse AI computing systems, users hope to have a unified evaluation metric for the system that provides AI computing power. The establishment of relevant real application performance evaluation benchmarks can objectively reflect the current state of the AI computing ability by providing objective metrics and comparison dimensions. This Recommendation provides an AI computing power benchmark framework, evaluation metrics and methods, and a guideline for technical testing for AI clusters.

[**ITU-T F.748.19 “Framework for audio structuralizing based on deep neural network”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=15196) presents an overview of the framework for audio structuralizing based on deep neural network. It provides a high-level description of architecture, processing flows, data categories, audio processing tasks and requirements for data management.

[**ITU-T F.748.20 “Technical framework for deep neural network model partition and collaborative execution”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=15197)**:** Deep neural network (DNN) model inference process usually requires a large amount of computing resources and memory. Therefore, it is difficult for end devices to perform DNN models independently. It is an effective way to implement end-edge collaborative DNN execution through DNN model partition, which can reduce latency and improve resource utilization at the same time. This recommendation aims to specify the technical framework of DNN model partition and collaborative execution. First, it is necessary to predict the overall inference latency under the current system state according to different DNN partition strategies in advance. Then, choose the appropriate partition locations and collaborative execution strategy based on the equipment computation capabilities, network status and DNN model properties. Finally, implement the model collaborative execution and optimize the resource allocation in the meanwhile.

[**ITU-T F.748.21 “Requirements and framework for feature-based distributed intelligent systems”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=15198) introduces the use cases, classification of features and framework for feature-based distributed intelligent systems relevant to intelligent scenarios, specifying the service requirement, functional requirements, and security requirements for feature-based distributed intelligent systems.

[**ITU-T F.749.6 “Requirements of vehicle information for automated driving in vehicle gateway platforms”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=15541) specifies the requirements of vehicle information for automated driving in vehicle gateway platforms. This Recommendation introduces vehicle information for automated driving system (ADS), followed by two different approaches to represent ADS-dedicated vehicle (ADS-DV) by its ownership. Finally, this Recommendation specifies the requirements to support two different approaches to represent ADS-DV.

**ITU-T F.749.16 “Requirements for logistics express delivery based on civilian unmanned aerial vehicle” (under approval)**: At present, logistics express delivery based on civilian unmanned aerial vehicles (CUAVs) is developing rapidly all over the world. Compared with general water transportation and land transportation, CUAV transportation has the advantages of low cost and flexible scheduling, and can make up for the shortcomings of traditional air transportation. It will change people’s consumption mode. Recommendation ITU-T F.749.16 provides the requirements for the service system and management of CUAV logistics express delivery.

[**ITU-T F.751.5 “Requirements for distributed ledger technology-based power grid data management”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=15199) defines requirements for distributed ledger technology (DLT)-based power grid data management, including framework of DLT-based power grid data management, requirements for infrastructure layer, requirements for service layer, requirements for application layer and requirements for data governance. This Recommendation can be used as a guideline for power grid data management with DLT technologies.

[**ITU-T F.751.6 “Performance assessment methods for distributed ledger technology platforms”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=15200) is an extension to the ITU-T F.751.1 and focuses on distributed ledger technology (DLT) performance assessment methods. Based on the performance assessment criteria defined in ITU-T F.751.1, this Recommendation defines specific performance metrics and relevant workflow for the quantitative performance assessment for DLT platform. This Recommendation can be used as a guideline of DLT platform performance assessment for developers, users, third party testers and researchers.

[**ITU-T F.751.7 “Functional assessment methods for distributed ledger technology platforms”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=15201) defines functional assessment methods for DLT platforms based on the assessment criteria defined in ITU-T Recommendation F.751.1. For each item of the assessment criteria defined in ITU-T F.751.1, one test case is defined in this Recommendation accordingly. The description of each test case is composed of test purpose, test workflows and expected results.

[**ITU-T F.760.1 “Requirements and reference framework for emergency rescue systems”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=15202) describes the application scenarios, functional requirements, and reference architecture of pre-hospital emergency rescue and applies to the planning and designing emergency rescue systems in emergency centres, hospitals and other medical institutions. The appendix to this Recommendation includes some use cases of the proposed reference system.

[**ITU-T H.222.0 (Ed.8) Amd.1 “Information technology - Generic coding of moving pictures and associated audio information: Systems: Carriage of LCEVC and other improvements”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=14658) extends the specification by defining how LCEVC (ISO/IEC 23094-2) is carried over MPEG-2 systems. It also defines an additional descriptor signalling the kind of media service and its usage. Further, it includes clarifications for the specification of carriage of JPEG XS. It does this in a compatible way with existing support for other codecs.

[**ITU-T H.627.3 “Protocols for intelligent video surveillance systems”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=15204) defines protocols for intelligent video surveillance systems, including the functional architecture, functional interface, overall requirements of the protocol, message flows and relevant protocols. This Recommendation is based on Recommendation ITU-T H.626.5, "Architecture for intelligent video surveillance systems".

[**ITU-T H.644.5 “Functional architecture of content request routing service in multimedia content delivery networks”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=15205) specifies the functional architecture with the related functional components of CRRS, the Reference points of a CRRS within MCDN. With the consideration of different network environment, content/service types and user/terminal device profile, this Recommendation also presents the potential solutions with the procedurals for CRRS to complete the end-user-to-MCDN node attachment under the case of IPTV service (dedicate network), OTT media service (public/open Internet) and mobile media streaming service (5G network with MEC enabled service). With this Recommendation, a MCDN service provider and manufacturer can deploy their MCDN node, especially the edge node, deeper into network edge. The CRRS provides a comprehensive solution to guide user to find the nearest MCDN node for accessing the request content by ignoring the differentiation of network, service type and terminal device and user’s location.

[**ITU-T T.807 (V2) “Information technology – JPEG 2000 image coding system: Secure JPEG 2000”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=15208) extends security capabilities of Rec. ITU-T T.800 | ISO/IEC 15444-1 ("JPEG 2000"). The 1st edition of this Recommendation | International Standard dates to 2007, and it has since then been supplemented by one amendment that include file format-based security. This 2nd edition addresses this amendment without modifying its scope. This Recommendation was developed jointly with ISO/IEC JTC 1/SC 29/WG 1 (JPEG), and is common text with ISO/IEC 15444-8. This second edition cancels and replaces the first edition, which has been technically revised. The main changes compared to the previous edition are as follows:

- Clause 7 ("JPSEC registration authority"), which was never created or used, is deprecated;

- Annex D ("Patent statements") is deprecated;

- the File Format Security is added; and

- solved/outstanding amendments and corrigenda are consolidated.

[**ITU-T T.808 (V2) “Information technology – JPEG 2000 image coding system: Interactivity tools, APIs and protocols”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=15209)**:** This second edition cancels and replaces the first edition, which has been technically revised. The main changes compared to the previous edition are as follows:

1. consolidates all outstanding amendments and corrigenda published since the first edition;

2. extends support for the file format specified in Rec. ITU-T T.815 | ISO/IEC 15444-16;

3. clarifies normative server responsibilities in response to certain request fields documented in Annex C;

4. removes the registration authority (Annex L); and

5. adds media type registration information (Annex O).

[**ITU-T T.816 (V1) “Information technology - JPEG 2000 image coding system: Extensions for coding of discontinuous media”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=15206)provides extensions of the scalable image coding tools described in Rec. ITU-T T.800 | ISO/IEC 15444-1 and Rec. ITU-T T.801 | ISO/IEC 15444-2, of two types. First, new wavelet-like image transforms known as "breakpoint-dependent" transforms are defined, whose underlying basis functions can be discontinuous at defined locations within the image component to which they are applied. Second, new scalable coding tools are described for a new type of image component known as a "breakpoint component," which provides a successively refinable and hierarchical description of the breakpoint locations used by the breakpoint-dependent transforms. Any non-initial component or components within a codestream conforming to this Recommendation | International Standard can be breakpoint components and any or components in the codestream other than breakpoint components can use a breakpoint-dependent transform that depends upon one of the breakpoint components in the same codestream. These new tools together allow for the scalable coding of imagery that naturally exhibits strong discontinuities in the spatial domain. An important example of such imagery is depth maps. This Recommendation was developed jointly with ISO/IEC JTC 1/SC 29/WG 1 (JPEG) and is common text with ISO/IEC 15444-17.

[**ITU-T Technical Paper FSTP.ACC-WebVRI “Guideline on web-based remote sign language interpretation or video remote interpretation (VRI) system”**](https://www.itu.int/pub/publications.aspx?lang=en&parent=T-TUT-EHT-2022-FSTP.ACC)**:** Due to the COVID-19 pandemic, the practice of physical distancing makes it difficult for a sign language interpreter to accompany a deaf or a hard of hearing person when the latter visits places such as a government agency, a school, a meeting, or a hospital. It is now almost imperative that a remote sign language interpretation, or a video remote interpretation (VRI) be implemented. During the time of physical distancing when almost any schooling and medical consultation needs to be done remotely, a non-interoperable VRI system for deaf and hard of hearing persons will exclude them from important social services. It is therefore important to have a standard guideline for a VRI or VRI system, which considers interoperability and future effectiveness. Considering the immediacy of the need as well as the cost of system introduction and practicality of the implementation, such a guideline is most likely to be based on web-based technologies. This Technical Paper describes a web-based VRI, based on Web real time communication (RTC), and describes how it can be used in a scenario where community sign language interpreters can participate, as well as ways in which other remote services, online medical treatment and distance education, can harmonize with the Web-based VRI system.

[**ITU-T Technical Paper FSTP-VS-SDCA “Application of software-defined camera in surveillance industry”**](https://www.itu.int/pub/publications.aspx?lang=en&parent=T-TUT-VS-2022-1) introduces several use cases of software-defined camera in multiple surveillance scenarios, analyses the possible requirements and pain points that customers may put forward, providing guidance for the further development of software-defined camera technology in the future. This technical paper also specifies the entire software-defined camera system ecosystem mechanism and security implementations. This technical paper aims to provide a comprehensive guidance for SDC technology usage in surveillance industry.

I.4.1 Internet of Things and Smart City

**ITU-T X.1353 “Security methodology for zero-touch deployment in massive IoT based on blockchain” (under approval)**: Massive Internet of Things (mIoT) is a significant application of future communication networks. With diverse use cases anticipated in mIoT, it is difficult for manufacturers to pre-install their manufactured IoT devices with mobile-operator-specific and/or service-specific information (e.g., identities and keys), since manufacturers may not know where their devices will eventually be deployed and activated. The current approach relies on customers’ manual configuration which is acceptable for small-scale IoT applications. However, for mIoT devices, the aforementioned approach is unacceptable due to the fact that manual configuration is time consuming, cost-ineffective and cumbersome. Thus, automatic credential provisioning without user involvement, known as "zero-touch" is needed for mIoT. This Recommendation provides a security methodology for designing a decentralized identity management system to support the zero-touch deployment of future mIoT. Zero-touch deployment will enable IoT devices to automatically find their mobile network operator and their service provider, automatically obtain credentials from them and automatically connect to the network and the service. This will greatly facilitate the future deployment of mIoT devices for verticals. The content of this Recommendation covers the security architecture, the security considerations and the related security procedures (such as device attestations, authentication, and credential provisioning) which are needed for building such a zero-touch mIoT deployment platform.

**[ITU-T Y.4218 “IoT and ICT requirements for deployment of smart services in rural communities”](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=15481):** There are numerous efforts underway to provide the necessary tools for the transformation into smart cities, but similar efforts are not observed with the transformation to smart rural communities. This is considered a digital divide in most developing countries where the population in those rural areas is mainly dependent on agriculture, forestry, dairy production, fisheries, livestock farming, etc., for its livelihood. They have limited access to good hospitals, schools, banks etc. in the rural areas, which can have an impact on the quality of their life. As a result, there is continued migration from rural to urban areas in search of higher paid jobs, better education and improved health care. These issues can be alleviated by bridging the digital divide, which may be achieved by enhancing the access of Information and Communication Technology (ICT) services (telephony as well as high speed Internet) in rural communities. As the ICT density, both voice and Internet is lower in rural areas compared to urban ones, therefore a high speed communication network may be established as a backbone for providing reliable ICT services. Provisioning of high speed internet facilities at the household or local community level will open new opportunities for the rural population in a number of diverse fields. The perspective of every household having access to at least one smart phone with a minimum set of required features and the internet may enable access to various online services, thereby reducing the digital divide.

This Recommendation aims to contribute to bridge the digital divide by establishing the ICT and IoT requirements for deployment of smart services (such as e-Government, tele-health, tele-education, precision agriculture etc.) in rural communities.

[**ITU-T Y.4219 “Accessibility requirements for user interface of smart applications supporting IoT”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=15482)**:** The use of IoT may increase the quality of life among persons with disabilities, persons with age-related disabilities and those with specific needs when properly designed. There are many possible IoT services in various environments that provide accessibility services as well. The IoT also can be used to create tools for persons with many types of disabilities and specific needs, including physical, visual, hearing and cognitive disabilities. IoT services interact with a user through the user interface. To ensure an IoT service is accessible, the user interface must be accessible. An accessible user interface must take into account a user's physical, audio and visual capabilities and consider compatibility with any assistive technology used by the user. This Recommendation outlines essential requirements that a user interface must consider in order to secure the accessibility of smart applications.

[**ITU-T Y.4220 “Requirements and capability framework of abnormal event detection system for smart home”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=15483)**:** By deploying IoT devices, smart home make use of IoT technologies to collect ambient information, detect abnormal event at home and report to relevant personnel or institute. In this Recommendation with “abnormal event” it is intended a human health injury event at home. Examples of abnormal events at home include, but are not limited to, cough, dyspnea, falls, headache, quiescent behaviour, sleep apnea, stroke, transient ischemic attacks. Such a smart home system aims to reduce injuries and casualties at home. Various products have emerged in this field. However, the lack of standards could limit the abilities of vendors to meet the raising demands across the globe, such as lower false alarm rate, more convenient deployment, better handling of privacy concerns, etc. In order to ensure the system quality, this Recommendation specifies the requirements and capability framework of the abnormal event detection system for smart home.

**ITU-T Y.4221 “Requirements of IoT-based electric power infrastructure monitoring system” (under approval)**: An IoT-based electric power infrastructure monitoring system is an effective means to obtain the operation health status of electric power infrastructures. It provides advanced and efficient auxiliary monitoring and diagnosis methods for maintaining the safe and stable operation of electric power system and improving the comprehensive management level of power system. Thus, it brings great convenience for maintaining electric power infrastructures. This Recommendation specifies the requirements specific to an IoT-based electric power infrastructure monitoring system for the purpose of maintaining electric power infrastructure.

**ITU-T Y.4222 “Framework of smart evacuation in a disaster and/or an emergency in smart cities and communities” (under approval):** Smart evacuation facilitates effective and efficient solutions for people inside the disaster and/or emergency zone and for people who approach the disaster and/or emergency zone. IoT and smart cities and communities provide possibilities to use their functionalities to provide smart evacuation during the incidence of a disaster and/or an emergency. This Recommendation describes concepts and features of smart evacuation control in disaster and/or emergency situations. It identifies high-level requirements and ICT infrastructure for smart evacuation along with use cases of disaster and/or emergency situations. The introduction of a smart evacuation service will allow maintaining the level of comfort achieved in a smart city for the population even in the event of an emergency of natural or man-made origin. This is fundamental to justify the enormous material costs for the rapid development of smart cities around the world against the background of natural and man-made emergencies that have become more frequent in all parts of the world.

**ITU-T Y.4223 “Common requirements and capabilities of smart cities and communities from IoT and ICT perspectives” (under approval)**: SC&C share the goal of achieving urban sustainability without sacrificing the quality of life (QoL) of their citizens. SC&C strive to create a sustainable living environment for citizens using Internet of things (IoT) technologies and information communication technologies (ICTs). SC&C standardization is ongoing in ITU-T and other relevant SDOs, including - but not limited to - SC&C framework, infrastructure, integrated sensing and management system, platform, data processing and services and applications (e.g., smart water management, smart buildings, smart residential community, smart tourism, smart parking lots, amongst many others). Based on the fundamental characteristics of smart cities and communities, this Recommendation specifies common requirements and capabilities of SC&C from IoT and ICT perspectives. The specified common requirements and capabilities are intended to be generally applicable in SC&C.

**[ITU-T Y.4485 “Requirements and Reference Architecture of Smart Education”](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=15484)** specifies requirements and reference architecture of smart education to support IoT-based education services, devices and management. This Recommendation provides concept, features and technical challenges of smart education requirements, reference architecture and common capabilities of the smart education different layers.

[**ITU-T Y.4486 “Framework of cross edge decentralized service by using DLT and edge computing technologies for IoT devices”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=15485)**:** Decentralized services such as distributed ledger technology (DLT) service for Internet of things (IoT) devices are usually deployed in local area networks (LANs) or in core clouds. When only deployed in LANs, the decentralized services may be affected by the limited capabilities of storage, computation and communication of IoT devices. When only deployed in core clouds, the decentralized services may be affected by the communication capabilities between the IoT devices in LANs and the peers in core clouds. With the popularization of the use of edge computing, parts or all of functionalities of the decentralized services can be deployed in edge clouds. This Recommendation introduces a cross edge decentralized service (CEDS) by using DLT and edge computing technologies, which supports seamless cross edge DLT services for IoT devices (fixed and mobile) by using DLT and edge computing technologies. The CEDS can take the advantages of edge computing to speed up the service efficiency of DLT services for IoT devices. In addition, the CEDS provides adaptive service management to match the dynamic changes of IoT devices. This Recommendation provides relevant general characteristics and requirements of the decentralized service by using DLT and edge computing technologies, and also provides its functional framework, common capabilities and general procedures.

**ITU-T Y.4487 “A functional architecture of roadside multi-sensor data fusion systems for autonomous vehicles” (under approval):** With the development of autonomous driving, methods by relying solely on the vehicle's own sensors or by traditional roadside sensing systems lacking collaboration between devices are no longer sufficient to support higher-level autonomous driving applications, and a higher requirement of roadside perception capabilities is proposed. The roadside multi-sensor data fusion system can provide new functionalities which will contribute to enhancing the roadside perception capabilities by combining different types of roadside sensing devices such as cameras, lidars, millimeter wave radars, etc. according to their characteristics, and perform unified management and coordination, so as to achieve accurate perception of road information, and support autonomous driving applications. This Recommendation defines a reference functional architecture of roadside multi-sensor data fusion systems. It clarifies the concept and components of the systems, and specifies the key functional entities of the systems and the reference points between the functional entities. Use cases based on roadside multi-sensor data fusion systems are also provided in the appendix.

**ITU-T Y.4488 “Framework of IoT service for safety protection of working environment” (under approval)**: By deploying IoT service, working environment makes use of IoT technologies to collect information remotely, identify risky behavior, equipment coordination, etc. These technologies could support intelligent services such as safety protection information monitoring including workers and environment, predictive maintenance, etc., which can help to reduce incidents and casualties, and improve the safety level of working environment. This recommendation specifies the framework of IoT service for safety protection of working environment.

[**ITU-T Y.4500.3 ”oneM2M - Security solutions”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=15076) provides specifications for machine to machine (M2M) security and privacy protection.

[**ITU-T Y.4560 (revised) “Blockchain-based data exchange and sharing for supporting Internet of things and smart cities and communities”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=15490)**:** Blockchain is an emerging technology, its most important characteristics are traceable, un-erasable, immutable, and time-stamped. It is able to efficiently ensure integrity, authenticity, and auditability for all transactions. Blockchain has important impacts and benefits for data exchange and sharing in support of Internet of things (IoT) and smart cities and communities (SC&C). In most of the IoT and SC&C scenarios, it is necessary to ensure data processing, circulation, sharing and management for all trust operations. Blockchain technologies can meet these needs. Recommendation ITU-T Y.4560 specifies the requirements, functional models, a platform, and deployment modes of blockchain-based data exchange and sharing for supporting IoT and SC&C.

**[ITU-T Y.4601 “Requirements and capability framework of digital twin for smart firefighting”](https://www.itu.int/itu-t/recommendations/rec.aspx?id=15077)**: A digital twin is a digital representation of an object of interest, and may require different capabilities according to the specific domain of application such as synchronization between a physical thing and its digital representation, and real-time support [ITU-T Y.4600]. Through the IoT technology deployment and the information integration process, a digital twin can provide high fidelity digital representation of the fire scene, enable dynamic convergence between the physical entity and digital entity, and achieve comprehensive understanding and control of the past, present, and future of the fire scene. The current state of the art for firefighting lacks comprehensive dynamic sensing capability and prediction capability, it cannot provide delayed information, and adequate visibility of the interaction between personnel and fire scene. Through the deployment of gateways, sensors, high quality network, multi-physics simulation, dynamic analysis and prediction, 3D visualizations. The smart firefighting digital twin enables intelligent services such as personnel tracking, hazard tracking, fire scene dynamic analysis, rescue strategy optimization, pre-simulation, historical scene reconstruction, etc., these intelligent services can help to improve decision-making processes and reduce the casualties. This Recommendation specifies the requirements and capability framework of digital twin for smart firefighting.

[**ITU-T Y.4602 “Data processing and management framework for IoT and smart cities and communities”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=15486)describes the data processing and management (DPM) framework organized into five dimensions that are data lifecycle dimension, trust dimension, data commercialization dimension, data ecosystem dimension and data governance dimension. The DPM framework covers all applications and services for IoT and Smart Cities and communities. It provides the high-level view of the DPM capabilities required at each stage of the data lifecycle considering different inherent aspects to the data such as its source (personal data, legacy data, and public data) and external aspects that are the actions to be applied to the data following the data manipulation, sharing, security and governance requirements.

[**ITU-T Y.4603 “Requirements and functional model to support data quality management in IoT”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=15487)**:** Data quality management is the mature processes, tools, and in-depth understanding of data you need to make decisions or solve problems to minimize risk and impact to your organization or customers. Data quality management in IoT is the practice of using that IoT data to serve your purposes with flexibility and agility for IoT applications. To do this, it is necessary to assess what data you have today and the processes and tools that use or support data against purposes and requirement of IoT applications. The requirements for data and its quality vary from IoT application to application or organization in different contexts. Data quality management practice in IoT makes data a holistic asset, by which it means that data is the input and output of every task and transaction performed according to IoT application for a business. This Recommendation specifies key requirements with respect to data quality management in IoT and important elements to fulfil these requirements. This document indicates the requirements and functional model in terms of the scopes of the followings: data quality management in IoT, requirements of data quality management in IoT and Functional model to support data quality management.

**ITU-T Y.4604 “Metadata for camera sensing information of autonomous mobile IoT devices” (under approval):** In case of low-cost and low-resolution IoT camera sensor’s devices, it is not necessary to support full-featured camera sensing information due to resource-limited IoT device capabilities. In contrast, a traditional full-performance digital camera device provides complex metadata such as camera settings (stimulus, sensitivity, shutter speed, etc.), time, location information, camera model, etc. As well, there is no guidance for compliant and compromised IoT camera sensing metadata from different manufacturers. It causes problems not to interchangeable among metadata, so it is crucial to provide basic and minimal camera sensing metadata to enable interoperable IoT applications and services. This draft Recommendation defines metadata for camera sensing information (MCSI) and describes details for characteristics and features of individual MCSI working on IoT devices.

**[ITU-T Y.4909 “Assessment framework of IoT sensing quality”](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=15488):** IoT systems are implemented by relevant stakeholders to increase the effectiveness, efficiency and the quality of sensing services. All IoT systems depend on the acquisition and use of sensing information. Sensing quality directly impacts the quality of service provided by the IoT systems. Sensing quality assessment framework of IoT systems provides a unified framework for both developers and users to evaluate sensing quality in IoT systems.

[**ITU-T Y.4910 “Maturity model of digital supply chain for smart sustainable cities”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=15489)**:** With the rapid development of advanced information technologies such as the Internet of Things, big data and cloud computing, the traditional supply chain has been transformed into a digital supply chain. Digital supply chains may help to maintain high growth by reducing the operation cost and improving the efficiency of supply chain management with the help of digital methods. As a result, digital supply chains can assist with the construction and management of SSC. This Recommendation provides a maturity model of digital supply chain for SSC referring to the key performance indicators (KPIs) for SSC in [ITU-T Y.4900] and the maturity model for SSC in [ITU-T Y.4904]. Both of these Recommendations support the maturity model for digital supply chains. Its use has specific benefits for socioeconomic indicators, like: environmental sustainability, productivity, innovation, and trade. This maturity model helps identify the goals, levels, dimensions and assessment methods of digital supply chain for SSC. It is designed as a practical tool for city managers and all related stakeholders to study the performance and benefits of digital supply chain from economic, social and environmental perspectives. Thus, it gives general guidance for accurately assessing the maturity of digital supply chain and helping achieve sustainable development goals for SSC.

[**ITU-T Y.Suppl.73 “Concept and use cases of a digital twin in smart sustainable cities”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=15473): A digital twin is regarded as a virtual representation that serves as the real-time digital counterpart of a physical object or process. This Supplement defines the concept and describes use cases of digital twins in smart sustainable cities. It also identifies challenges and opportunities for digital twins in smart sustainable cities.

**ITU-T Technical Report ITU-T YSTR.BP-DTw “Best Practices for Graphical Digital Twins of Smart Cities” (under publication):** This example-based report focuses on how emerging technology solutions can best address environmental issues within cities. The data used is based on information gained from the United Nations ''United for Smart Sustainable Cities” reports [b-U4SSC 2020]. Industrial Internet of Things (IoT) and smart cities gather a lot of data in data lakes and present the insights generated by machine learning or artificial intelligence in custom proprietary dashboards or in open APIs. It is a tedious task for stakeholders with low data literacy to apprehend so much information and in so many data formats in a way that helps them bend their decisions and adapt their behaviours towards a more sustainable future. In light of the United Nations’ 2030 Agenda for Sustainable Development and the European Commission’s Fit-for-55 programmes, there is a critical need for a visualisation tool which can help visualise and compare, in a consistent manner, the sustainability of smart cities in such a way that priorities can be identified and anchored at all decision-making levels and best practices can be scaled-up and replicated to other cities. The purpose of the document is thus to identify the emerging technologies which allow a prompt comparison between different cities and help detect low hanging fruits and areas of high priorities. In the sake of convenience and reproducibility, attention is drawn to potential universal data formats.

**ITU-T Technical Report TR\_AccountingIOT “Accounting & Billing aspects in IoT ecosystem and integrated approach using Distributed Ledger Technology (DLT)” (under publication)** studies the various accounting, billing and related challenges in the IoT ecosystem and to analyse the usage of Distributed Ledger Technology (DLT) to provide an integrated approach to the management of IoT. In addition, it presents various principles and models on this subject and records the best practices followed by Member States. This technical report discusses the various challenges faced in the accounting, billing and related areas in the Internet of Things (IoT) ecosystem. The exponential growth of digital interactions and the increasing use of IoT devices to collect and transmit data has created the need for modern billing systems that are well-integrated with businesses and capable of accommodating complex business models and pricing structures. The challenges in Accounting and Billing in the IoT ecosystem include long and complex value chains, fragmented business and financial architecture, limited support from traditional billing solutions, auditing provisions, compliance to accounting standards, reconciliation and settlements across platforms, and transparency in pricing models. The success of the IoT ecosystem depends on how the financials are managed and how Accounting and Billing aspects play a critical role in capturing every strand of transactions accurately, efficiently, and without errors. This report intends to study these challenges in the Accounting, Billing, and related areas of the IoT ecosystem, exploring the principles and models on the subject, and analyzing the usage of Distributed Ledger Technology (DLT) as an integrated approach to IoT management.

**ITU-T Technical Report dSTR-IoTM2M-Roaming “Roaming Aspects of IoT and M2M” (under publication)** addresses roaming aspects of the Internet of Things (IoT) and machine-to-machine (M2M) communications. Following an overview of IoT/M2M communications, it discusses business models and policy challenges. The report also includes illustrative case studies from the European Union (EU), Republic of Korea, and India. This report encourages policymakers to support clear, harmonized light-touch regulatory frameworks that enable investments by the private sector. By using the information in this report, Member States may consider various roaming business models in order to adopt an approach that suits them best and supports innovation and technology development in their respective jurisdictions.

I.4.2 Connected vehicles, automated driving and intelligent transport systems

**[ITU-T F.749.6 “Requirements of vehicle information for automated driving in vehicle gateway platforms”](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=15541)** specifies the requirements of vehicle information for automated driving in vehicle gateway platforms. This Recommendation introduces vehicle information for automated driving system (ADS), followed by two different approaches to represent ADS-dedicated vehicle (ADS-DV) by its ownership. Finally, this Recommendation specifies the requirements to support two different approaches to represent ADS-DV.

[**ITU-T Supplement H.Sup20 “Practice for intelligent traffic sensing device deployment in the roadside”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?rec=15213)**:** The detection and analysis of traffic elements based on roadside sensing devices is an important foundation for intelligent transportation. Sensing devices used in roadside to build an intelligent transport system generally include cameras, lidars, millimetre wave radars, etc. The requirements for sensing devices, such as the deployment and the function characteristics will affect the quality of data for intelligent transportation system. In order to support ITS to obtain comprehensive and effective perception data, this supplement gives the practice references for roadside sensing devices’ deployment in ITS. This Supplement applies to ITU-T H.550-H.599 series: Vehicular gateways and intelligent transportation systems (ITS).

[**ITU-T X.1377 “Guidelines for an intrusion prevention system for connected vehicles”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=15103) establishes guidelines for an intrusion prevention system (IPS) for connected vehicles. This Recommendation mainly focuses on aspects of active response capability for intrusion and includes the implementation guidance and use cases of IPS for connected vehicles. Prior in-vehicle intrusion detection systems (IDSs) have limitations, e.g., requiring too many computing resources that a vehicle cannot provide and being unable to mitigate intrusions due to characteristics of protocol and bus topology. To address these limitations of conventional in-vehicle IDSs, this Recommendation provides methodologies for intrusion detection and intrusion prevention. The proposed IPS consists of the intrusion detection plane – an external component that calculates intrusion detection algorithms – and the data plane – in-vehicle networks (IVNs) where traffic monitoring and active response happen. This Recommendation aims to protect (automotive) Ethernet-based IVNs.

[**ITU-T X.1381 “Security guidelines for Ethernet-based In-Vehicle networks”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=15107) provides security guidelines for Ethernet-based in-vehicle networks (IVNs). The current trend in electrical and electronic (E/E) architecture is to integrate the Ethernet with legacy IVNs such as the controller area network (CAN), local interconnect network (LIN), media-oriented systems transport (MOST) and FlexRay. In the past, the Ethernet was considered only as a connection between vehicles with external environments. Standard protocols that enable Internet protocol-based connections over the Ethernet (e.g., diagnostic communication over Internet protocol or universal measurement and calibration protocol) have been used to enable communications between the external environment and vehicles. These use cases generally do not need to meet stringent real-time constraints. However, in-vehicle applications using Ethernet communication require characteristics that include high time sensitivity and reliability. Current developments in in-vehicle communication technologies require increased bandwidth in the network. Compared to the Ethernet, legacy IVNs are insufficient to meet the bandwidth requirements of current in-vehicle applications. Therefore, now and in the future, Ethernet-based IVNs are a major part of E/E architecture. However, countermeasures known from common computer networks cannot be suitable for an automotive application because they were not designed with regard to automotive requirements and capabilities. To address this demand, this Recommendation provides security guidelines for automotive Ethernet technology. This Recommendation includes a reference model of automotive Ethernet and analysis of threat and vulnerability for Ethernet-based IVNs. In addition, this Recommendation provides security requirements and use cases of Ethernet-based IVNs.

[**ITU-T X.1382 “Guidelines for sharing security threat information on connected vehicles”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=15104): Connected vehicles are facing increasingly prominent network security issues along with their rapid development. Security threat information of connected vehicles means any information that can help an organization identify, assess, monitor, and respond to the connected vehicle, which plays an integral role in securing connected vehicles. Organizations that share threat information for connected vehicles can improve their own security postures and those of other organizations. This Recommendation is a guide on the principles, rules, methodology and procedures of sharing security information for connected vehicles. This Recommendation also provides a brief description of the different scopes, roles and effectiveness of the various organizations while they engage in the life cycle of security threat information sharing. This Recommendation is intended to help organizations stay in touch with the existing shared community. Furthermore, this Recommendation helps organizations contribute to the threat information of a connected vehicles sharing community, which would support the practices of connected vehicles safety protection. Overall, this Recommendation aims to enhance security threat information sharing; and mitigate the potential impact of cyber security attacks on connected vehicles.

[**ITU-T X.1383 “Security requirements for categorized data in vehicle-to-everything (V2X) communication”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=15108)**:** Data security is one of the most important works for vehicle-to-everything (V2X) communication. However, in a resource constrained environment such as in-vehicle communication, a lot of resources are consumed protecting data as cryptographic functions are required. This Recommendation categorizes the data used in V2X communication into several types such as object attribute data, vehicle status data, environmental perception data, vehicle control data, application service data and user personal data, and assigns three security levels for categorized data types. Based on these categorized data types and assigned data security levels, this Recommendation provides security requirements for categorized data in V2X communication.

**ITU-T Y.4487 “A functional architecture of roadside multi-sensor data fusion systems for autonomous vehicles” (under approval):** With the development of autonomous driving, methods by relying solely on the vehicle's own sensors or by traditional roadside sensing systems lacking collaboration between devices are no longer sufficient to support higher-level autonomous driving applications, and a higher requirement of roadside perception capabilities is proposed. The roadside multi-sensor data fusion system can provide new functionalities which will contribute to enhancing the roadside perception capabilities by combining different types of roadside sensing devices such as cameras, lidars, millimeter wave radars, etc. according to their characteristics, and perform unified management and coordination, so as to achieve accurate perception of road information, and support autonomous driving applications. This Recommendation defines a reference functional architecture of roadside multi-sensor data fusion systems. It clarifies the concept and components of the systems, and specifies the key functional entities of the systems and the reference points between the functional entities. Use cases based on roadside multi-sensor data fusion systems are also provided in the appendix.

I.4.3 Digital health

[**ITU-T F.760.1 “Requirements and reference framework for emergency rescue systems”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=15202) describes the application scenarios, functional requirements, and reference architecture of pre-hospital emergency rescue and applies to the planning and designing emergency rescue systems in emergency centres, hospitals and other medical institutions. The appendix to this Recommendation includes some use cases of the proposed reference system.

[**ITU-T F.780.1 (V3) “Framework for telemedicine systems using ultra-high definition imaging”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=15546)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 for medical practices that use endoscopes and/or microscopes. This Recommendation also describes a list of requirements for using a UHD-based "endoscopic video camera" as a medical device. In addition, Annex A describes the requirements on the use of this technology as a medical device. This revision adds the clause for profiles of UHD imaging for medical services, as well as new definitions and abbreviations.

[**ITU-T F.780.2 (V2) “Accessibility of telehealth services”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=15547) defines accessibility requirements for technical features to be used and implemented by governments, healthcare providers and manufacturers of telehealth platforms to facilitate the access and use of telehealth services by persons with disabilities and specific needs, including older persons with age-related disabilities.

With the passage of the United Nations Convention on the Rights of Persons with Disabilities in 2006, and its ratification by numerous countries, persons with disabilities have the right to enjoy the highest attainable standard of health without discrimination on the basis of disability. Countries need to take all appropriate measures to ensure access for persons with disabilities to health services.

During the current Covid-19 pandemic, the use of telehealth services has increased substantially in many countries and telehealth has become a basic need for the general population, especially for those in quarantine, enabling patients in real time through contact with healthcare providers to access advice. However, due to the lack of global and comprehensive standards and guidelines for accessibility of telehealth services, many persons with disabilities experience difficulties accessing and using such services and are often forgotten. This Recommendation summarizes and defines those requirements and features that industries can implement to ensure accessible provision of telehealth services.

Technical requirements defined in this Recommendation are based on a comprehensive feedback collected from civil society on barriers that persons with disabilities experience when accessing and using telehealth services, as well as on the feedback from the industry. This is a first edition of the document.

This Recommendation was developed collaboratively by the World Health Organization (WHO) and ITU.

[**ITU-T F.780.3 “Use cases and requirements for ultra-high-definition teleconsulting system”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=15203) describes the use cases and technical requirements of ultra-high-definition (UHD) teleconsulting system. UHD teleconsulting system is an important application of UHD display technology and ICT in the medical field, under the background of unbalanced medical resources, especially the COVID-19 pandemic, which can realize the optimal allocation of medical resources and benefit people in areas with less developed medical resources. It recommends the framework, functional requirements, and performance requirements of UHD teleconsulting system which are the necessary hardware and software foundations for teleconsultation. Finally, the Recommendation gives two application cases of UHD teleconsulting system in Appendix I, including the roles of different participants, as well as the teleconsultation process. The Recommendation is suitable for the development, construction and evaluation of UHD teleconsulting system in different countries and regions.

[**ITU-T H.845.10 (revised) “Conformance of ITU-T H.810 personal health system: Personal Health Devices interface Part 5J: Insulin pump”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=15207): This edition includes the corrections approved in ITU-T H.845.10 (2017) Corrigendum 1 (11/2017), and the maintenance contents from ISO/IEEE 11073-20601:2022 and ISO/IEEE 11073-10419:2019 (Insulin Pump) versions.

**[ITU-T Technical Paper FSTP-CONF-F780.1 “Conformance testing specification for F.780.1 - Framework for telemedicine systems using ultra-high definition imaging"](https://www.itu.int/pub/publications.aspx?lang=en&parent=T-TUT-EHT-2022-FSTP.CONF.F780.1)** defines the testing specification for F.780.1 "Framework for telemedicine systems using ultra-high definition imaging".

I.5.1 New security standards

**ITU-T X.1051 (revised) “Information security, cybersecurity and privacy protection - Information security controls based on ISO/IEC 27002 for telecommunications organizations” (under approval)**: This Recommendation | International Standard:

a) establishes guidelines and general principles for initiating, implementing, maintaining and improving information security controls in telecommunications organizations based on ISO/IEC 27002;

b) provides an implementation baseline of information security controls within telecommunications organizations to ensure the confidentiality, integrity and availability of telecommunications facilities, services and information handled, processed or stored by the facilities and services.

As a result of implementing this Recommendation | International Standard, telecommunications organizations, both within and between jurisdictions, will:

a) be able to ensure the confidentiality, integrity and availability of global telecommunications facilities, services and the information handled, processed or stored within global facilities and services;

b) have adopted secure collaborative processes and controls ensuring the lowering of risks in the delivery of telecommunications services;

c) be able to deliver information security in an effective and efficient manner;

d) have adopted a consistent holistic approach to information security;

e) be able to improve the security culture of organizations, raise staff awareness and increase public trust.

[**ITU-T X.1219 “Functional requirements for a secured process to evaluate technical vulnerabilities”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=15542)**:** The vulnerabilities evaluation by crowdsourcing is a good manner for famous online systems to find their technical vulnerabilities, but on the other hand, there are still many problems or challenges such as the shell script uploaded by members of a security team was not deleted after evaluation, resulting in a backdoor in the system. The functional requirements for a secured process to evaluate technical vulnerabilities are recommended in this recommendation. And the functional requirements with corresponded mechanisms would be mainly used to solve the lack of trust in the crowdsourcing manner. It is meaningful to make sure that the vulnerabilities evaluation operated by security teams be reliable, auditable, traceable, and controllable.

**[ITU-T X.1277.2 “Universal authentication framework (UAF) protocol specification”](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=15543)**: The goal of the universal authentication framework is to provide a unified and extensible authentication mechanism that supplants passwords while avoiding the shortcomings of current alternative authentication approaches. This approach is designed to allow the relying party to choose the best available authentication mechanism for a particular end user or interaction, while preserving the option to leverage emerging device security capabilities in the future without requiring additional integration effort. This Recommendation describes the architecture in detail, it defines the flow and content of all UAF protocol messages and presents the rationale behind the design choices.

NOTE: This technically equivalent protocol is based on the work in FIDO Alliance Client to Authenticator Protocol (CTAP).

[**ITU-T X.1278.2 “Client to authenticator protocol version 2.1”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=15544) describes an application layer protocol for communication between a roaming authenticator and another client/platform, as well as bindings of this application protocol to a variety of transport protocols using different physical media. The application layer protocol defines requirements for such transport protocols. Each transport binding defines the details of how such transport layer connections should be set up, in a manner that meets the requirements of the application layer protocol.

Note: This Recommendation is technically equivalent to FIDO Alliance Client to Authenticator Protocol (CTAP)].

**ITU-T X.1353 “Security methodology for zero-touch deployment in massive IoT based on blockchain” (under approval)**: Massive Internet of Things (mIoT) is a significant application of future communication networks. With diverse use cases anticipated in mIoT, it is difficult for manufacturers to pre-install their manufactured IoT devices with mobile-operator-specific and/or service-specific information (e.g., identities and keys), since manufacturers may not know where their devices will eventually be deployed and activated. The current approach relies on customers’ manual configuration which is acceptable for small-scale IoT applications. However, for mIoT devices, the aforementioned approach is unacceptable due to the fact that manual configuration is time consuming, cost-ineffective and cumbersome. Thus, automatic credential provisioning without user involvement, known as "zero-touch" is needed for mIoT. This Recommendation provides a security methodology for designing a decentralized identity management system to support the zero-touch deployment of future mIoT. Zero-touch deployment will enable IoT devices to automatically find their mobile network operator and their service provider, automatically obtain credentials from them and automatically connect to the network and the service. This will greatly facilitate the future deployment of mIoT devices for verticals. The content of this Recommendation covers the security architecture, the security considerations and the related security procedures (such as device attestations, authentication, and credential provisioning) which are needed for building such a zero-touch mIoT deployment platform.

[**ITU-T X.1380 “Security guidelines for cloud-based data recorders in automotive environments”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=15106)**:** The purpose of this Recommendation is to standardize security guidelines for cloud-based data recorders in automotive environments. This Recommendation describes threats, vulnerabilities, security requirements, and use cases for cloud-based data recorders in automotive environments. Event data recorders are one of the most important components installed in automotive road vehicles in order to record vehicle status, vehicle movements and user inputs during crashes. Through analysing the event data, we can understand the cause of a crash and eventually use it to improve safety in automotive environments. A data storage system for automated driving is also an important component to record a set of data that will give a clear picture of the interactions between the driver and the automated driving system. However, conventional event data recorders record and manage the whole data locally, and in this way the data might come under threats of loss and destruction. Meanwhile, cloud computing is being considered an enabler of network access to a scalable and elastic pool of shareable physical or virtual resources with self-service provisioning and administration on-demand. Industries such as the aviation industry are already attempting to apply cloud services to event data recording systems to increase safety in the aviation environment. According to the current trend of connectivity among the vehicles, the event data recorders and the data storage system for automated driving in automotive will be implemented to increase their overall safety. However, They have various vulnerabilities in the process of collecting, transferring, storing, managing, and using the recorded data according to the distinctive characteristics of the automotive environment. Therefore, it is necessary to study these vulnerabilities, security requirements, and use cases for cloud-based data recorders in automotive environments.

[**ITU-T X.1381 “Security guidelines for Ethernet-based In-Vehicle networks”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=15107) provides security guidelines for Ethernet-based in-vehicle networks (IVNs). The current trend in electrical and electronic (E/E) architecture is to integrate the Ethernet with legacy IVNs such as the controller area network (CAN), local interconnect network (LIN), media-oriented systems transport (MOST) and FlexRay. In the past, the Ethernet was considered only as a connection between vehicles with external environments. Standard protocols that enable Internet protocol-based connections over the Ethernet (e.g., diagnostic communication over Internet protocol or universal measurement and calibration protocol) have been used to enable communications between the external environment and vehicles. These use cases generally do not need to meet stringent real-time constraints. However, in-vehicle applications using Ethernet communication require characteristics that include high time sensitivity and reliability. Current developments in in-vehicle communication technologies require increased bandwidth in the network. Compared to the Ethernet, legacy IVNs are insufficient to meet the bandwidth requirements of current in-vehicle applications. Therefore, now and in the future, Ethernet-based IVNs are a major part of E/E architecture. However, countermeasures known from common computer networks cannot be suitable for an automotive application because they were not designed with regard to automotive requirements and capabilities. To address this demand, this Recommendation provides security guidelines for automotive Ethernet technology. This Recommendation includes a reference model of automotive Ethernet and analysis of threat and vulnerability for Ethernet-based IVNs. In addition, this Recommendation provides security requirements and use cases of Ethernet-based IVNs.

[**ITU-T X.1382 “Guidelines for sharing security threat information on connected vehicles”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=15104): Connected vehicles are facing increasingly prominent network security issues along with their rapid development. Security threat information of connected vehicles means any information that can help an organization identify, assess, monitor, and respond to the connected vehicle, which plays an integral role in securing connected vehicles. Organizations that share threat information for connected vehicles can improve their own security postures and those of other organizations. This Recommendation is a guide on the principles, rules, methodology and procedures of sharing security information for connected vehicles. This Recommendation also provides a brief description of the different scopes, roles and effectiveness of the various organizations while they engage in the life cycle of security threat information sharing. This Recommendation is intended to help organizations stay in touch with the existing shared community. Furthermore, this Recommendation helps organizations contribute to the threat information of a connected vehicles sharing community, which would support the practices of connected vehicles safety protection. Overall, this Recommendation aims to enhance security threat information sharing; and mitigate the potential impact of cyber security attacks on connected vehicles.

[**ITU-T X.1383 “Security requirements for categorized data in vehicle-to-everything (V2X) communication”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=15108)**:** Data security is one of the most important works for vehicle-to-everything (V2X) communication. However, in a resource constrained environment such as in-vehicle communication, a lot of resources are consumed protecting data as cryptographic functions are required. This Recommendation categorizes the data used in V2X communication into several types such as object attribute data, vehicle status data, environmental perception data, vehicle control data, application service data and user personal data, and assigns three security levels for categorized data types. Based on these categorized data types and assigned data security levels, this Recommendation provides security requirements for categorized data in V2X communication.

[**ITU-T X.1410 “Security architecture for data-sharing management based on the distributed ledger technology”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=15109)specifies a security architecture of data-sharing management based on distributed ledger technologies (DLTs). Based on the architecture, this Recommendation specifies the interfaces between the functional entities and the procedures of data-sharing management based on DLT. Distributed ledger technology is transforming the industries with innovative solutions and changing the way governments, institutions, and businesses operate. It provides a solution for securely replicating, sharing, and synchronizing data across a distributed computer network, considering its decentralization and tamper-proof features. Current approaches for sharing business data and personally identifiable information (PII) data with companies and digital platforms have led to privacy vulnerabilities from hacks or poor data management. Adopting DLT or blockchain in data-sharing management allows individuals or companies to maintain more direct control over their own confidential information. In the DLT-based solution, only non-PII data, e.g., hashed data values, are stored in the on-chain. PII data about a data owner are stored in the off-chain. A DLT-based solution provides a way that improves the traceability, verifiability and changeability of status of data.

[**ITU-T X.1411 “Guidelines on blockchain as a service (BaaS) security”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=15110) provides generic guidelines for blockchain as a service (BaaS). The security threat and vulnerabilities of blockchain as a service (BaaS) are analysed, followed by the security measures of blockchain as a service (BaaS). The Recommendation addresses the security requirements and provides guidelines for all the activities in the construction, operation and use of BaaS. Blockchain as a service has become a mainstream of blockchain development, due to its promising capability and support from giant tech companies, especially top cloud providers. As blockchain as a service (BaaS) provides the fundamental service and resources for blockchain applications and BaaS security also faces challenges arising from both blockchain core technologies and cloud platforms, the guidance on blockchain as a service security is of great importance and a necessity.

[**ITU-T X.1412 “Security Requirements for Smart Contract Management based on the distributed ledger technology”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=15545)**:** Smart contract is widely used in the distributed ledger technology (DLT) system, and it is faced with a lot of security threats and challenges. This Recommendation analyses the security threats and challenges, and provides security requirements for smart contract management in DLT systems. This Recommendation can be used by smart contracts designers, developers, and managers to manage smart contracts, including design and development, compilation and deployment, invocation and execution, maintenance and management in DLT systems. This Recommendation does not deal with the security issues of wallets or distributed applications related to smart contracts.

**ITU-T X.1454 “Security measures for location enabled smart office service” (under approval):** The smart office service combining multiple smart applications aims to improve the quality of official businesses, and efficiency management. Since information and communication technologies (ICTs) serve as the basis for technologies in smart office services, the telecommunication operator plays an important role among stakeholders in smart office services. The typical smart office services include smart parking, smart driving, smart retail shop, smart office, smart meeting room management, smart water, and smart energy consumption management, etc. Among these typical smart office services, the location data provided by the operator is one of the key elements in most of these services implementations. In order to ensure the security of location enabled smart office services, security threats and relevant security requirements, specific to location enabled services need to be analysed and the overall security measures established. This draft Recommendation aims to analyse the typical application scenarios of location enabled smart office services, specifies the security threats and requirements that are specific to the location enabled services and thereby establishing security measures for the operator and key stakeholders in a smart office to safeguard location enabled services.

**ITU-T X.1471 “Reference monitor for online analytics services” (under approval):** Big data analysis service is based on the undefined unstructured data including user behaviour, purchase, payment, location and consuming of various internet contents. It can provide new insights not previously discovered and predicts future states. However, some un-authorized data can be used maliciously in the analysis process. This Recommendation describes a reference monitor for big data analytics and operations to detect an un-authorized data use. The Recommendation analyses security threats and challenges in the big data analytics, and describes security considerations that could mitigate these threats and address security challenges with access control mechanisms. A reference monitor methodology based on access control is provided for determining which of these security capabilities are required for mitigating security threats and addressing security challenges for big data analytics.

**[ITU-T X.1644 “Security guidelines for distributed cloud”](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=15112)** analyses security threats and challenges on distributed cloud and propose security guidelines against threats for distributed cloud, which includes the security guidelines for core cloud, regional cloud and edge cloud.

**ITU-T X.1645 “Requirements of network security situational awareness platform for cloud computing” (under approval)**: Network security situational awareness (NSSA) is derived from “situational awareness”. It usually includes four processes: data acquisition, security situation analysis, security situation assessment and security situational tendency projection, and generally has the following capabilities: 1) the capability of detection and persistent monitoring various attack threats, abnormal behaviour and their scope of influence; 2) the capability of data mining, threat analysis, and the traceability of abnormal behaviour; 3) the capability of security prediction and early warning; 4) the capability of visualization of security situation. For cloud computing service providers, NSSA platform plays an important role in improving cloud computing's security protection, the ability to detect security breaches or anomalous behaviours, security decision-making and emergency response ability, and even it can help improve the early warning mechanism for cloud computing. This recommendation will first introduce the concept and development of network security situational awareness, analyze the advantages of NSSA coping with the security challenges of cloud computing, then aim to document the requirements for network security situational awareness platform for cloud computing.

**ITU-T X.1771 “Requirements for data de-identification assurance” (under approval)**: De-identified data incurs the risk of re-identifying individuals. So, it is important to assess the threat that de-identified data is used to identify individuals through re-identification methods. De-identification methods, which can be used for re-identification risk assessment, may be selected accordingly based on the following considerations:

- Data risk assessment: Data composition, data distribution, possession of other data,

- Data use environment risk assessment: Confidence level of data recipient, impact during re-identification, inadvertent re-identification,

- Using and managing de-identification data: Security measures for de-identification data, monitoring of re-identification possibilities, compliance with de-identification data provision or consignment contracts.

Recommendation ITU-T X.1771 defines data de-identification assurance. It also provides a set of requirements for managing data de-identification assurance, including data risk assessment, risk assessment of the data use environment, and using and managing de-identified data.

**[ITU-T X.1815 “Security guidelines and requirements for IMT-2020 edge computing services”](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=15113)**: The IMT-2020 network will enable a variety of services, including enhanced mobile broadband (eMBB) services, massive machine type communications (mMTC) based services and ultrareliable low latency communications (URLLC) based services, on an infrastructure of network and computing resources. In line with the key features and the requirements identified for the IMT-2020 network, it is required to be more efficient, personalized, intelligent, reliable and flexible. To support the typical services in the IMT-2020 network, especially eMBB services and URLLC based services, edge computing is acknowledged to be one of the key technologies for meeting the demanding key performance indicators (KPIs) of the IMT-2020 network, especially as far as low latency and bandwidth efficiency are concerned. Edge computing enables the operator and the third party service provider to deploy the services close to the user's access point, thus achieving high-efficiency service delivery through reduced end-to-end latency and load on the transport network. In order to ensure the security of edge computing service deployment and application, the security threats and relevant security requirements specific to edge computing service need to be analysed and the overall security framework need to be established. This Recommendation aims to analyses the deployment scheme and typical application scenarios of edge computing services, specifies the security threats and requirements specific to edge computing services in IMT-2020 and thus establishes security capabilities for the operator to safeguard its applications.

[**ITU-T X.1816 “Guidelines and requirements for classifying security capabilities in IMT-2020 network slice”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=15114): The definition of basic network slicing technology functions and processes has laid a solid foundation for the first wave of IMT-2020 deployment and commercial use of network slicing services. As an end-to-end logical network that is customized on demand, slicing can provide differentiation security capabilities: First, the IMT-2020 network slicing provides the supporting security measures for the differentiated network implementation. Second, the IMT-2020 network supports some optional security measures at the slice level. Some security measures can also provide multiple security options and operators may own different security resources. These may bring different degrees of security guarantee or non-security performance. Slice customers also have specific security requirements and may request customized network slices with different security protection levels from slice operators. There exist some challenges for the slice customers or the slice operators choosing the security capabilities of their slices such as management cost and definition inconsistency, etc. The objective of this Recommendation is to provide a description of differentiated IMT-2020 network slice security capabilities and guideline for classifying the IMT-2020 network slice security capabilities and IMT-2020 network slice security to help the ecosystem more clearly understand and choose the slicing security capabilities.

**ITU-T X.1817 “Security requirements for 5G message service” (under approval)** provides the security requirements for 5G messaging service, including use security requirements, management security requirements and control security requirements for 5G messaging service.

[**ITU-T Y.2247 “Framework and requirements of network-oriented data Integrity verification service based on blockchain in future network”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=15247) specifies the network-oriented data integrity verification service based on blockchain in future networks. It provides the service requirements, framework and service scenarios of the network-oriented data integrity verification service based on blockchain and specifies the network capability requirements accordingly in the context of future networks including IMT-2020 network and beyond. Detailed descriptions of the use cases are listed in the appendix.

[**ITU-T Y.3813 “Quantum key distribution networks interworking – functional requirements”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=15243): For quantum key distribution networks (QKDN), Recommendation ITU-T Y.3813 specifies functional requirements for QKDN interworking (QKDNi). This Recommendation describes the functional requirements for key management layer, QKDN control layer, and QKDN management layer, for interworking using gateway nodes (GWNs) and/or interworking nodes (IWNs).

[**ITU-T Y.3814 “Quantum key distribution networks - functional requirements and architecture for machine learning enablement”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=15244)**:** QKDN is expected to maintain stable operations and meet the requirements of various cryptographic applications efficiently. Due to the advantages of machine learning (ML) related to autonomous learning, ML can help to overcome the challenges of QKDN in terms of quantum layer performances, key management layer performances and QKDN control and management efficiency. Based on the functional requirements and architecture of QKDN in [ITU-T Y.3801] and [ITU-T Y.3802], this recommendation is to specify one possible set of functional requirements and a possible architecture for ML-enabled QKDN (QKDNml), including the overview, the functional requirements, architecture and operational procedures of QKDNml.

[**ITU-T Y.4500.3 “oneM2M - Security solutions”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=15076) provides specifications for M2M security and privacy protection.

**ITU-T TR.ibc-cd “Guidelines for identity based cryptosystems used for cross-domain secure communications” (under publication)**: Secure communications take place not only within an operator’s network but also across operators’ networks. Public key cryptosystem has become the foundation for the secure communications since it has been invented. Identity-based public key cryptography (ID-PKC) system has the advantage over the PKI-based public key cryptography (PKI-PKC) system as ID-PKC remove the need for the certificate management. However, current bootstrap schemes for ID-PKC rely on the availability of the PKI. Multi-CA trust issue in the PKI-PKC system is transmitted to the ID-PKC system. In this technical report, the secure bootstrap of an ID-PKC without relying on PKI is studied. The weaknesses of current IBC system for cross-domain secure communications are identified. Potential solutions to overcome the weaknesses are introduced. Further, the evaluation of these solutions and way forward to standardization are given.

I.5.2 Quantum key distribution networks

**[ITU-T Y.3813 “Quantum key distribution networks interworking – functional requirements”](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=15243)**: For quantum key distribution networks (QKDN), Recommendation ITU-T Y.3813 specifies functional requirements for QKDN interworking (QKDNi). This Recommendation describes the functional requirements for key management layer, QKDN control layer, and QKDN management layer, for interworking using gateway nodes (GWNs) and/or interworking nodes (IWNs).

[**ITU-T Y.3814 “Quantum key distribution networks - functional requirements and architecture for machine learning enablement”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=15244): QKDN is expected to maintain stable operations and meet the requirements of various cryptographic applications efficiently. Due to the advantages of machine learning (ML) related to autonomous learning, ML can help to overcome the challenges of QKDN in terms of quantum layer performances, key management layer performances and QKDN control and management efficiency. Based on the functional requirements and architecture of QKDN in [ITU-T Y.3801] and [ITU-T Y.3802], this recommendation is to specify one possible set of functional requirements and a possible architecture for ML-enabled QKDN (QKDNml), including the overview, the functional requirements, architecture and operational procedures of QKDNml.

[**ITU-T Y.Sup.74 to ITU-T Y.3800-series Recommendations “Standardization roadmap on Quantum Key Distribution Networks”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?rec=15511) provides the standardization roadmap on quantum key distribution networks. It describes the landscape with related technical areas of trust technologies from an ITU-T perspective and list up related standards and publications developed in standards development organizations (SDOs).

[**ITU-T Y.Sup.75 to ITU-T Y.3000-series “Quantum key distribution networks – Quantum-Enabled Future Networks”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?rec=15522) describes ITU-T’s Views for Quantum-Enabled Future Networks (QEFN) for the future networks study to act as a document to help SG13 to study the future network evolution towards Quantum era.

I.5.3 Trust

**ITU-T Y.2073 “Framework of trusted electricity brokerage for distributed energy resources” (under approval):** Due to the rapid spread of distributed energy resources, the demand for intermediary trading (i.e., brokerage) of surplus electricity for energy prosumers in electricity markets is significantly increasing. To support transparency of brokerage transactions in the trading process, various technologies such as blockchain can be applied to applications that require mutual trust between users in a trustless environment. Thus, this Recommendation provides a framework of trusted electricity brokerage for distributed energy resources taking into account the blockchain technology for trust provisioning in electricity markets. After introducing key characteristics, core technologies and service scenarios for trusted electricity brokerage with the necessity of the blockchain technology to ensure trust, this draft Recommendation mainly presents requirements, architecture overview specifying related interfaces and functional blocks for the blockchain enabled trusted electricity brokerage.

[**ITU-T Y.3140 “Service brokering network framework for Trusted Reality”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=15236) describes service brokering network framework for Trusted Reality featuring application-aware brokering capabilities in terms of context, data and computation. The service brokering network framework for Trusted Reality aims to deliver customized immersive application service experience with real-time communication and recognition of knowledge and information in a safe and convenient way for anyone throughout the automated connection of real and cyber world.

I.5.4 Distributed Ledger Technology

[**ITU-T F.751.5 “Requirements for distributed ledger technology-based power grid data management”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=15199) defines requirements for distributed ledger technology (DLT)-based power grid data management, including framework of DLT-based power grid data management, requirements for infrastructure layer, requirements for service layer, requirements for application layer and requirements for data governance. This Recommendation can be used as a guideline for power grid data management with DLT technologies.

[**ITU-T F.751.6 “Performance assessment methods for distributed ledger technology platforms”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=15200) is an extension to the ITU-T F.751.1 and focuses on distributed ledger technology (DLT) performance assessment methods. Based on the performance assessment criteria defined in ITU-T F.751.1, this Recommendation defines specific performance metrics and relevant workflow for the quantitative performance assessment for DLT platform. This Recommendation can be used as a guideline of DLT platform performance assessment for developers, users, third party testers and researchers.

[**ITU-T F.751.7 “Functional assessment methods for distributed ledger technology platforms”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=15201) defines functional assessment methods for DLT platforms based on the assessment criteria defined in ITU-T Recommendation F.751.1. For each item of the assessment criteria defined in ITU-T F.751.1, one test case is defined in this Recommendation accordingly. The description of each test case is composed of test purpose, test workflows and expected results.

**ITU-T F.751.8 “Technical framework for distributed ledger technology (DLT) to cope with regulation” (under approval)** defines the technical framework for distributed ledger technology (DLT) to cope with regulation, including regulatory challenges and technical capacities. The design of the technical framework of DLT in this Recommendation is closely related to DLT properties including decentralization, immutability and openness. This Recommendation can be used as guidance for the DLT system when facing regulation for DLT service providers and DLT system developers.

[**ITU-T M.3366 “Requirements for management of blockchain system”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=15519) introduces requirements for management of blockchain system, includes configuration management, performance management, fault management and log management related to blockchain node, blockchain ledger, smart contract, consensus, account, etc., in blockchain system. This Recommendation proposes management requirements for private chains or permissioned chains.

**[ITU-T X.1410 “Security architecture for data-sharing management based on the distributed ledger technology”](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=15109)** specifies a security architecture of data-sharing management based on distributed ledger technologies (DLTs). Based on the architecture, this Recommendation specifies the interfaces between the functional entities and the procedures of data-sharing management based on DLT. Distributed ledger technology is transforming the industries with innovative solutions and changing the way governments, institutions, and businesses operate. It provides a solution for securely replicating, sharing, and synchronizing data across a distributed computer network, considering its decentralization and tamper-proof features. Current approaches for sharing business data and personally identifiable information (PII) data with companies and digital platforms have led to privacy vulnerabilities from hacks or poor data management. Adopting DLT or blockchain in data-sharing management allows individuals or companies to maintain more direct control over their own confidential information. In the DLT-based solution, only non-PII data, e.g., hashed data values, are stored in the on-chain. PII data about a data owner are stored in the off-chain. A DLT-based solution provides a way that improves the traceability, verifiability and changeability of status of data.

[**ITU-T X.1411 “Guidelines on blockchain as a service (BaaS) security”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=15110) provides generic guidelines for blockchain as a service (BaaS). The security threat and vulnerabilities of blockchain as a service (BaaS) are analysed, followed by the security measures of blockchain as a service (BaaS). The Recommendation addresses the security requirements and provides guidelines for all the activities in the construction, operation and use of BaaS. Blockchain as a service has become a mainstream of blockchain development, due to its promising capability and support from giant tech companies, especially top cloud providers. As blockchain as a service (BaaS) provides the fundamental service and resources for blockchain applications and BaaS security also faces challenges arising from both blockchain core technologies and cloud platforms, the guidance on blockchain as a service security is of great importance and a necessity.

[**ITU-T Y.2247 “Framework and requirements of network-oriented data Integrity verification service based on blockchain in future network”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=15247) specifies the network-oriented data integrity verification service based on blockchain in future networks. It provides the service requirements, framework and service scenarios of the network-oriented data integrity verification service based on blockchain and specifies the network capability requirements accordingly in the context of future networks including IMT-2020 network and beyond. Detailed descriptions of the use cases are listed in the appendix.

[**ITU-T Y.2345 “Scenarios and requirements of network resource sharing based on distributed ledger technology”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=15530) aims to provide the overview and general framework of the network resource sharing based on distributed ledger technology and specifies scenarios and capability requirements which are derived from use cases.

[**ITU-T Y.3082 “Mobile network sharing based on distributed ledger technology for networks beyond IMT-2020: Requirements and framework”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=15246) specifies the requirements and framework of distributed ledger technology used in mobile network sharing for networks beyond IMT-2020. The detailed requirements of distributed ledger technology based mobile network sharing are put forward. The high-level framework, service procedures and security considerations are presented. The detailed use cases are described in the appendix.

[**ITU-T Y.4486 “Framework of cross edge decentralized service by using DLT and edge computing technologies for IoT devices”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=15485)**:** Decentralized services such as distributed ledger technology (DLT) service for Internet of things (IoT) devices are usually deployed in local area networks (LANs) or in core clouds. When only deployed in LANs, the decentralized services may be affected by the limited capabilities of storage, computation and communication of IoT devices. When only deployed in core clouds, the decentralized services may be affected by the communication capabilities between the IoT devices in LANs and the peers in core clouds. With the popularization of the use of edge computing, parts or all of functionalities of the decentralized services can be deployed in edge clouds. This Recommendation introduces a cross edge decentralized service (CEDS) by using DLT and edge computing technologies, which supports seamless cross edge DLT services for IoT devices (fixed and mobile) by using DLT and edge computing technologies. The CEDS can take the advantages of edge computing to speed up the service efficiency of DLT services for IoT devices. In addition, the CEDS provides adaptive service management to match the dynamic changes of IoT devices. This Recommendation provides relevant general characteristics and requirements of the decentralized service by using DLT and edge computing technologies, and also provides its functional framework, common capabilities and general procedures.

[**ITU-T Y.4560 (revised) “Blockchain-based data exchange and sharing for supporting Internet of things and smart cities and communities”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=15490)**:** Blockchain is an emerging technology, its most important characteristics are traceable, un-erasable, immutable, and time-stamped. It is able to efficiently ensure integrity, authenticity, and auditability for all transactions. Blockchain has important impacts and benefits for data exchange and sharing in support of Internet of things (IoT) and smart cities and communities (SC&C). In most of the IoT and SC&C scenarios, it is necessary to ensure data processing, circulation, sharing and management for all trust operations. Blockchain technologies can meet these needs. Recommendation ITU-T Y.4560 specifies the requirements, functional models, a platform, and deployment modes of blockchain-based data exchange and sharing for supporting IoT and SC&C.

I.6.1 Green ICT standards

[**ITU-T L.1061 “Circular public procurement of information and communication technologies”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=15469)**:** Green procurement policies, which focus on purchasing durable information and communication technology (ICT) equipment and recycling e-waste, can help reduce emissions and resource extractions and influence the market by increasing demand and stimulating research and product development. This Recommendation provides technical guidance to public sector organizations on improving their procurement practices to purchase more circular ICT goods and services. The Recommendation covers the purchase of ICT equipment such as personal computers, terminals, network equipment and servers, and imaging equipment, and recommends specific requirements in procurement to (1) minimise the generation of e-waste and its adverse effects, (2) maximise the use of energy efficient equipment, (3) maximize the useful life of equipment, and (4) maximize recyclability. It also covers design for e-waste prevention and procurement recommendations which are relevant for the management choices of the e-waste hierarchy, as well as specific requirements and guidance on procurement to enhance the energy efficiency, reduce Green House Gas (GHG) emissions to mitigate climate change and reduce the emissions of hazardous substances in e-waste.

[**ITU-T L.1306 “Specification of edge data center infrastructure”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=15175) makes systematic requirements on infrastructure including ICT equipment, power feedingsystem, cooling system, monitoring system, etc. to get green, safe, reliable, smart, energy-saving for edge data center.

**[ITU-T L.1630 “Framework of building infrastructure management system for sustainable city”](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=15176)**: One of the sustainable development goals of sustainable city is to build resilient and safe city assets. Building is one of the key city assets and closely related with circular and sustainable city. Typically, energy and firefighting equipment are key equipment within the building infrastructure, which may affect the safety of people. Currently, many energy and firefighting equipment are separately deployed and managed, so there exist gaps between energy equipment management and firefighting equipment management. This Recommendation defines the framework of building infrastructure management system which improves the sustainability of city, particularly building as a city asset. The framework provides a holistic management of building infrastructure. It also presents a service use cases composed of functional elements.

[**ITU-T L.1400 (revised) “Overview and general principles of methodologies for assessing the environmental impact of Information and Communication Technologies”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=15182) presents the general principles on assessing the environmental impact of information and communication technologies (ICT) and outlines the different methodologies that have been developed in the L.14xx-series:

• Assessment of the environmental impact of ICT goods, networks, and services

• Assessment of the environmental impact of ICT projects

• Assessment of the environmental impact of ICT in organizations

• Assessment of the environmental impact of ICT in cities

• Assessment of the environmental impact of the ICT sector

• Assessment on how the use of ICT solutions impacts GHG emissions of other sectors

• Decarbonization trajectories for the ICT sector

• Net zero guidance for ICT organizations

• Guidance on how to address the ITU´s Connect 20xx targets

The Recommendation describes the intended usage of each Recommendation and the connections between them. Finally, it lists ongoing work items.

[**ITU-T L.1480 “Enabling the Net Zero transition: Assessing how the use of ICT solutions impacts GHG emissions of other sectors”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=15030) provides methodology for assessing how the use of ICT solutions impacts GHG emissions of other sectors. More specifically, the methodology provides guidance on the assessment of the use of ICT solutions covering the net second order effect (i.e. the resulting second order effect after accounting for the emissions due to the first order effects of the ICT solution), and the higher order effects such as rebound. By providing a structured methodological approach, it aims to improve consistency, transparency and comprehensiveness of assessments of how the use of ICT solutions impact GHG emissions over time. Guidance is provided to assess the net second order effect and higher order effects of the following cases:

- ICT solution(s) implemented in a specific context by the user of the ICT solution

- ICT solution(s) implemented at different scales, including at an organizational level (whether private or public organizations), at a city level, at a country level or at worldwide level.

- ICT solution(s) seen from the perspective of an ICT organization contributing to the ICT solution. This includes

o Assessment of the aggregated effect of all ICT solutions provided by an ICT organization across all its customers

o Assessment of the aggregated effect of one or several ICT solution(s) provided by an ICT organization across some of its customers

o Assessment of the effect of one or several specific ICT solution(s) implemented in an actual context for a specific customer..

[**ITU-T L.1481 “Guidance on how to address Connect2030 targets on net abatement”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=15031) provides guidelines on how to address the Connect 2030 greenhouse gas on net telecommunication/ICT-enabled Greenhouse Gas abatement. It is intended to be utilized by relevant stakeholders of the Connect 2030 ambitions, while considering the sustainable development goal (SDG) 13 and the objectives of the Paris Agreement and the Glasgow Climate Pact. It also presents examples of ICT solutions associated with a potential reduction of GHG emissions in other sectors.

**[ITU-T L.Suppl.52 “Guidelines on the Implementation of environmental efficiency Criteria for AI and Other Emerging Technologies”](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=15168)** provides guidelines to policymakers, technologists, innovators, environmentalists, and other stakeholders from the technology industry, environmental sciences, and policy arena, on the topic of environmental efficiency criteria to assess the environmental impacts of artificial intelligence and other emerging technologies. These guidelines aim to serve as common factors, rather than a comprehensive list, for the above-mentioned stakeholders to consider while developing, deploying, and promoting any piece of technology into the market and society. While “emerging technologies” is a broad term, this Supplement identifies a few sample technologies through their accordant applications and areas of work in 16 applicable industry domains, which we hope our stakeholders can use as references to improve the environmental efficiency of their own technological products and/or services. When discussing environmental efficiency, this Supplement approaches environmental efficiency criteria from an adjusted model of Life Cycle Assessment of Product, with which three stages of environmental impacts – Materials, Use, and End of life – are examined. The Supplement provides both long-term and short-term strategies, which include not only specific examples for certain technologies addressing the three stages of environmental efficiency, but also an instrument to be used to localize such guidelines as well as to allow global benchmarking.

[**ITU-T L.Suppl.53 “Computer processing, data management and energy perspective”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=15169) proposes a set of good practices to improve the energy efficiency of cyber-physical applications – making use of IoT, AI, and Digital Twins. First, the Supplement introduces the cyber-physical paradigm, engineering reference framework, and a couple of system deployments models. Secondly, it defines three end-to-end use case typologies to be addressed (i.e. monitoring application using smart IoT systems and AI software; smart application using Edge computing and Cloud data center; and simulation applications using Digital Twin pattern). Energy efficiency practices are discussed adopting a circular value-chain model that consists of three main steps: Data Storage; Data Transfer/Move; and Data Processing/Analytics. Finally, this Supplement offers a set of recommended practices relating to each component of the three end-to-end use case typologies.

[**ITU-T L.Suppl.54 “Guidance for assessing the GHG emissions consequences of the financial effects generated by ICT”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=15215) describes a guidance for assessing the GHG emissions consequences of a financial effects (gains or losses) generated by ICT, separately considering the user and the vendor financial benefits or losses from the solution. It thus assesses the GHG impact of this common case of rebound effect due to changes in behaviour.

[**ITU-T L.Suppl.55 “Environmental efficiency and impacts on United Nations Sustainable Development Goals of data centre and cloud computing”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=15216): As the role of data centre and cloud computing keeps increasing, so are the concerns over their energy use and energy cost, and the associated impacts on climate change and environment. In recent years, the data centre and cloud industry has made great progress in enhancing energy efficiency and adopting renewable energy sources. However, a sole focus on energy efficiency may cause burden shifting and overlook other relevant environmental impacts stemming from other parts of the data centres' life cycle and cloud computing value chain. Therefore, to support the development of sustainable data centres and cloud computing services, this Supplement aims to explore the environmental sustainability of data centres during their entire life cycle, factoring in a broad spectrum of energy and environmental aspects that needs to be addressed to achieve the relevant United Nations Sustainable Development Goals (SDGs). An integrated approach addressing both technical and implementation challenges will be applied to yield actionable insights to policy makers and industry experts.

[**ITU-T L.Suppl.56 “Guidelines for connecting cities and communities with the Sustainable Development Goal”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=15230) is based on the [U4SSC report on “Connecting cities and communities with the Sustainable Development Goals”](https://www.itu.int/en/publications/Documents/tsb/2017-U4SSC-Deliverable-Connecting-Cities/files/downloads/Deliverable-Connecting-Cities-and-Communities-422022.pdf) and provides an overview of how cities can use information and communication technologies (ICTs) to achieve the SDGs. It also maps the case studies to the various international agreements as well as the SDGs.

I.6.2 Electromagnetic fields

**ITU-T K.147 (revised) “Protection of networked information technology equipment” (under approval)** covers common one, two and four pair link implementations, their configurations, how surges are coupled into a system and what surge mitigation measures are used. Following this overview, the rationale for different surge and power fault test circuit approaches and when they are specified is given. Networked equipment can be subject to overvoltage and overcurrent transients. Both data and any powering services should be resistant to the expected environmental transients. Where equipment has multiple independent ports, such as central hubs, switches, or repeaters, then testing is required for inter-port resistibility. Resistibility testing needs to identify lightning transients coupled into a network by magnetic induction, earth potential rise, resistive coupling and transient coupling by a voltage-limiting operation of surge protective functions or flashover. Voltage limitation may convert common-mode surges into differential-mode surges in the signal path. It is also possible for alternating current mains power faults to couple into the network, which can necessitate the use of overcurrent protection.

[**ITU-T K.Suppl.16 (revised) “Electromagnetic field compliance assessments for 5G wireless networks”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=15229) 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 now lunched in many countries.

[**ITU-T K.Suppl.30 “ITU-T K.118 - Requirements for lightning protection of fibre to the distribution point equipment – Overview”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=15166)**:** Telephone lines are constantly being repurposed for digital use. This document looks at the lightning threats that repurposing for digital G.fast (Fast Access to Subscriber Terminals) may bring. Since the publication of Recommendation ITU-T K.118, 2016, Requirements for lightning protection of fibre to the distribution point equipment, the system, often called G.fast (fast access to subscriber terminals) with RPF (reverse power feed), has had extensive deployment. This supplement provides the subsequent informative references and materials that have appeared since the publication of ITU-T Recommendation K.118. The conventional telephone twisted pair connecting wire, termed the link (transmission path between two cabling system interfaces, including the connections at each end), between the Distribution Point Unit (DPU) and the Customer Premises Equipment (CPE) usually has a maximum length of up to 300 m. Electrical lightning stresses on the connected equipment at the link ends are considered to arise from the lightning disturbances on the CPE powering source, differential EPR (earth potential rise) of the link ends and possibly magnetic induction to the link cable. This supplement mainly concerns itself with the differential EPR values between the link ends.

[**ITU-T K.Suppl.31 “ITU-T K.118 - Requirements for lightning protection of fibre to the distribution point equipment – Modelling earth potential rise (EPR)”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=15167)**:** Since the publication of Recommendation ITU-T K.118, 2016, Requirements for lightning protection of fibre to the distribution point equipment, the system, often called G.fast (fast access to subscriber terminals) with RPF (reverse power feed), has had extensive deployment. This supplement provides an assessment earth potential rise (EPR) levels at the cabling link ends to the Distribution Point Unit (DPU) and the Customer Premises Equipment (CPE). Electrical lightning stresses on the connected equipment at the link ends are considered to arise from the lightning disturbances on the CPE powering source, differential EPR (earth potential rise) of the link ends and possibly magnetic induction to the link cable. This supplement mainly concerns itself with the link end EPR values.

[**ITU-T K.Suppl.32 “Case Studies of RF-EMF Assessment”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=15214): The RF-EMF exposure levels are varying depending on the environment in which they are taken and type of radio communication systems that are in operation. This Technical Report presents results of case studies of 5G RF-EMF exposure levels taken in different conditions and areas. All results of assessment delivered by ITU-T members and include calculations and measurements of the 5G RF-EMF exposure levels in vicinity of different radio communication systems. The results included in this new Supplement provide information concerning the 5G RF-EMF exposure levels in real situations. The EMF exposure assessments are included in succeeding appendixes. This new Supplement is mainly to solve the problem of EMF compliance assessments of 5G base station systems through the typical case studies including computation evaluation and measurement evaluation, and also provides the case support on implementation of the ITU-T K.Supplement 16 and IEC62232.

I.6.3 Naming, numbering, addressing and identification

[**ITU-T E.118.1 "** **Allocation, assignment and management global Issuer Identifier Numbers (IIN)"**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=15075) specifies the criteria by which the ITU-TSB shall allocate and assign global IINs, as well as the specific resources that will be managed.

**ITU-T E.1120 “Global ITU-T Naming, Numbering, Addressing and Identification assignment processes” (under approval)** details the processes to be used by an applicant, the Telecommunication Standardization Bureau (TSB), and ITU-T Study Group 2, for assignment of: E.164 identification codes (ICs), E.212 shared mobile country codes (MCC) for networks and their respective mobile network codes (MNCs), E.118 shared Issuer Identifier Numbers, and E.218 shared TETRA mobile network codes.

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

**ITU-T D.285 (revised) “Guiding principles for charging and accounting for intelligent network supported services” (under approval)** outlines general considerations and guiding principles for charging and international accounting for traffic and facilities used to support services that utilize Intelligent Networking (IN) capabilities.

**ITU-T Technical Report TR\_AccountingIOT “Accounting & Billing aspects in IoT ecosystem and integrated approach using Distributed Ledger Technology (DLT)” (under publication)** studies the various accounting, billing and related challenges in the IoT ecosystem and to analyse the usage of Distributed Ledger Technology (DLT) to provide an integrated approach to the management of IoT. In addition, it presents various principles and models on this subject and records the best practices followed by Member States. This technical report discusses the various challenges faced in the accounting, billing and related areas in the Internet of Things (IoT) ecosystem. The exponential growth of digital interactions and the increasing use of IoT devices to collect and transmit data has created the need for modern billing systems that are well-integrated with businesses and capable of accommodating complex business models and pricing structures. The challenges in Accounting and Billing in the IoT ecosystem include long and complex value chains, fragmented business and financial architecture, limited support from traditional billing solutions, auditing provisions, compliance to accounting standards, reconciliation and settlements across platforms, and transparency in pricing models. The success of the IoT ecosystem depends on how the financials are managed and how Accounting and Billing aspects play a critical role in capturing every strand of transactions accurately, efficiently, and without errors. This report intends to study these challenges in the Accounting, Billing, and related areas of the IoT ecosystem, exploring the principles and models on the subject, and analyzing the usage of Distributed Ledger Technology (DLT) as an integrated approach to IoT management.

**ITU-T Technical Report dSTR-IoTM2M-Roaming “Roaming Aspects of IoT and M2M” (under publication)** addresses roaming aspects of the Internet of Things (IoT) and machine-to-machine (M2M) communications. Following an overview of IoT/M2M communications, it discusses business models and policy challenges. The report also includes illustrative case studies from the European Union (EU), Republic of Korea, and India. This report encourages policymakers to support clear, harmonized light-touch regulatory frameworks that enable investments by the private sector. By using the information in this report, Member States may consider various roaming business models in order to adopt an approach that suits them best and supports innovation and technology development in their respective jurisdictions.

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

[**ITU-T G.113 Amd.3 (revised) “Transmission impairments due to speech processing – Amendment 3: Revised Appendix V - Provisional planning values for the fullband equipment impairment factor, and the fullband packet loss robustness factor and the fullband burstiness robustness factor”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=15458) contains an update to Appendix V of G.113, including the burstiness robustness factor to be used with the updated fullband E-model. The text is proposed for agreement at the Working Party and Study Group levels.

[**ITU-T G.107.2 (revised) “Fullband E-model”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=15461) 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 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.191 (revised) “Software tools for speech and audio coding standardization**”](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=15462) provides source code for speech and audio processing modules for narrowband, wideband and super-wideband telephony applications. The set includes codecs, filters, noise generators. This edition introduces changes to Annex A, which describes the ITU-T Software Tools (STL) containing a high-quality, portable C code library for speech processing applications. This release of the STL, also known as STL2023, incorporates:

• An implementation of P.50 fullband MNRU as described in ITU-T P.810.

• A tool for automatic instrumentation of speech and audio codecs to measure their computational complexity and memory.

Recommendation ITU-T G.191 includes an electronic attachment containing STL2023 and manual.

[**ITU-T G.1051 “Latency measurement and interactivity scoring under real application data traffic patterns”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=15468): An important aspect of data transmission performance of networks are data transfer times and resulting answering delay in real-time, interactive scenarios. Latency and reactivity are becoming even more essential for new interactive and real-time applications as e.g. in Augmented Reality but also in Industry 4.0 or automotive use. Latency and the resulting reactivity must be measured in a scenario that emulates the application and use-case to be evaluated. This requires first a data transfer profile (traffic pattern) that is considered as equivalent to the application so that the relevant latency and reactivity can be measured. Second, the resulting influence of latency to a certain application can be described by an interactivity scoring model. This model is not a general one, rather is individually scaled for each of the use cases like e.g. e-Gaming or real-time drone control and is focused on scoring transport with a simplified, parametrizable model approach, it does not target individual application behaviours.

[**ITU-T P.58 (revised) “Head and torso simulator for telephonometry”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=15463) specifies the electroacoustic characteristics of the head and torso simulator (HATS) to be used for telephonometric measurements. Both the sound generation and sound pick up characteristics of this device are specified. The artificial ears described in this Recommendation support narrowband, wideband, super-wideband, as well as full-band applications. The artificial mouth described in this Recommendation supports narrowband, wideband and super-wideband applications. However, it should be noted that the directionality of the artificial mouth is limited in its ability to simulate the human mouth in the super-wideband frequency range.

[**ITU-T P.381 (revised) “Technical requirements and test methods for analogue wired headsets/headphones and corresponding universal interface of terminals”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=15464) specifies critical physical and electrical-acoustical characteristics for the universal headset interface and provides corresponding test methods. Both 3.5 mm and 2.5 mm diameter headset/headphone interfaces have been widely used in digital mobile terminals in recent years. Nowadays, the consumer is free to choose either the headset/headphone originally provided by the terminal manufacturer or others that are offered separately. However, the quality of service (QoS)/quality of experience (QoE) perceived by users is influenced by both the electrical performance of the interface and the compatibility between the terminal and the connected headset/headphone.

[**ITU-T P.382 (revised) “Technical requirements and test methods for analogue wired multi-microphone headsets/headphones and corresponding universal interface of terminals”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=15465) specifies critical physical and electroacoustical characteristics for a universal headset interface with more than four terminals and provides corresponding test methods. Headset or headphone (HP) interfaces of diameter 3.5 mm and 2.5 mm have been widely used in digital mobile terminals during recent years. Nowadays, the consumer is free to choose either the headset or HP originally provided by the terminal manufacturer or others that are offered separately. However, the quality of service/quality of experience (QoS/QoE) perceived by users is influenced by both the electrical performance of the interface and the compatibility between the terminal and the connected headset or HP.

[**ITU-T P.383 (revised) “Technical requirements and test methods for digital headsets/headphones and corresponding interfaces of terminals”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=15466) specifies requirements and provides corresponding test methods for headsets and headphones as well as terminals when tested separately. Headsets and headphones equipped with wired or wireless digital interfaces have been widely used in digital mobile terminals in recent years. The consumer is free to choose either the headset or the headphone originally provided with the terminal or other headsets or headphones that are offered separately. However, the quality of service and quality of experience (QoS/QoE) perceived by users is influenced by both the electrical performance of the interface and the compatibility between the terminal and the headset or headphone.

**[ITU-T P.810 (revised) “Modulated Noise Reference Unit (MNRU)”](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=15467)** describes the Modulated Noise Reference Unit (MNRU), a standalone unit for introducing controlled degradations to speech signals. The MNRU has been used extensively in subjective performance evaluations of digital processes as reference conditions. Historically MNRU was implemented in analogue hardware. The Recommendation was subsequently complemented with the description of digital implementations of the MNRU for narrowband and wideband signals. This revision provides the extension of digital MNRU to fullband signals, which shapes the flat gaussian noise used in the narrowband and wideband version with an average speech power spectrum. The introduction of the shaped noise provides a more representative degradation for super-wideband and fullband speech as it reduces the energy of the noise towards high frequencies. A reference implementation of the algorithms is provided in the Software Tool Library (STL), ITU-T Rec. G.191.

[**ITU-T P.836 “Simulating Conversations for the Prediction of Speech Quality”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=15470) provides a conversation simulation model which is able to simulate realistic conversational behavior to produce conversations on the semantic level, as well as on the speech signal level. The simulation is able to replicate conversations with different interactivity patterns and the resulting simulated conversations will reflect changes of this conversation behavior due to delayed transmission and packet loss. The simulated conversations may be used to predict conversational quality in combination with signal-based or parametric quality prediction models, such as the E-model, e.g., in drive-test scenarios.

[**ITU-T P.1503 “Extended methodology for cross-country and inter-operator Digital Financial Services testing”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=15471) is based on ITU-T Rec. G.1033, where a conceptual framework for Quality of service and quality of experience aspects of digital financial services is standardized, and on ITU-T Rec. P.1502 which standardizes a methodology for QoE testing of digital financial services for the basic person-to-person (P2P) money transfers between two devices using the same network and DFS operator. The present document has three main parts.

Firstly, the methodological framework and use case definitions for a generalized P2P money transfer use case are given. In this framework, the DFS operator used to send money, and the operator receiving this very money (i.e. the A and B side of a money transfer) are parameters of the use case, which integrates all variations (same operator/inter-operators; same country/cross-country) into the same methodological context.

The second element of this Recommendation is a comprehensive framework for data elements and related processing, including tools and procedures providing operational robustness and a high level of data quality. The data objects defined here support test planning and management as well as provide the input data foundation for efficient processing of data. Also, guidance is given on how data processing can be done in a consistent and efficient way.

Last but not least, this Recommendation describes a new tool, and the corresponding methodology, designed to assist field test teams in data collection. This tool (“multi-stopwatch”) has already been conceptually suggested in ITU-T Rec. P.1502. It is an electronic time-taking tool similar to a stopwatch but supporting testers to record the events within a DFS test case and upload data entered by testers directly to a central location. This tool eliminates the needs and weaknesses of manual entering of time readings and the process of transferring them to post-processing through multiple transformation stages, e.g. from handwritten notes to entries in a spreadsheet.

[**ITU-T P.Suppl.29 “ITU-T Rec. P.800 use case examples”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=15459&lang=en) describes ITU-T P.800 use case examples that include NB, WB, SWB and FB audio bandwidth, speech, music and mixed speech and music content, stereo and spatial quality evaluations. Guidance for using subjective listening methodology in ITU-T Rec. P.800 for stereo and spatial speech and general audio content is described next in this Supplement. Anchor conditions, level normalization for stereo and multichannel signals, listener screening methods are presented.

[**ITU-T Y.1540 Amd.2 “Internet protocol data communication service - IP packet transfer and availability performance parameters - Amendment 2: Revised Annex B: Additional search algorithms for IP-based capacity parameters and methods of measurement**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=15491)**”** revises Annex B, which provides a second, more capable search algorithm for the IP capacity method of measurement defined in Annex A.

**ITU-T Y.3121 “QoS requirements and framework for supporting deterministic communication services in local area network for IMT-2020” (under approval)** specifies QoS requirements and framework for supporting deterministic communication services in a local area network (LAN). First, it presents the concept and benefits of deterministic communication services in a LAN consisting of heterogeneous network technologies. Then it specifies a high-level model and associated QoS requirements for inter- technology domain deterministic communication services in LAN. Based on the identified QoS requirements, it identifies a framework and an example operational procedure. Finally, it provides three scenarios and associated use cases as informal material in appendixes.

[**ITU-T Y.3122 “Quality of service assurance requirements and framework for smart grid supported by IMT-2020 and beyond”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=15531) specifies the quality of service (QoS) assurance aspects for the smart grid supported by the international mobile telecommunications 2020 (IMT-2020) and beyond. It first provides an overview of the smart grid supported by IMT2020 and beyond. It then identifies a number of QoS considerations. The QoS assurance requirements and framework based on the QoS considerations are specified. Finally, smart grid application scenarios with detailed QoS requirements supported by IMT2020 and beyond are described in appendix I.

[**ITU-T Y.3183 “Framework for network slicing management assisted by machine learning leveraging QoE feedback from verticals”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=15238) provides a framework for machine learning assisted network slicing management, leveraging vertical end users’ feedback on QoE, which can help achieve run-time optimisation of user perceived performance. The overall architecture, components, workflow and related APIs of this framework are specified with respect to the high-level requirements identified. A use case is provided in appendix to show an application example of this framework. Example implementations of the key APIs are also provided.

**[ITU-T Y.3811 “Quantum key distribution networks - Functional architecture for quality of service assurance”](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=15064)** specifies a functional architecture of QoS assurance for the quantum key distribution networks (QKDN). This recommendation first provides an overview of the functional architecture of QoS assurance for the QKDN. It then describes the functional architecture of QoS assurance which includes functional entities such as QoS data collection, data processing, data storage, data analytics, QoS anomaly detection and prediction, QoS policy decision making, and enforcement and reporting. Based on the functional entities described in the functional architecture, this Recommendation specifies a basic operational procedure of QoS assurance for the QKDN.

**ITU-T Technical Report JSTR-OPTR “Optimizing bitrates and transmission resolution by considering display characteristics and available bandwidth” (under publication)** provides subjective test results that can be used for optimal video transmission methods in terms of bitrates and resolution, which use the minimum bandwidth while providing equivalent perceptual video quality by considering content characteristics and display size/resolution.

I.9 Conformity, interoperability and testing

[ITU-T Q.4070 “Test suite for interoperability testing of virtualized broadband network gateway”](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=15255) specifies the interoperability testing of virtualized broadband network gateway (vBNG), including overview of test suite and test cases for interoperability testing of vBNG.

I.10 Signalling Protocols

[**ITU-T Q.3647 “Signalling requirements for emergency service in IMS roaming environment”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=15254) addresses the signalling requirements for emergency service in IMS roaming environment. It defines the signalling architecture, interfaces and functional description, signalling requirements, signalling procedures and security consideration of emergency service in home routing architecture of IP Multimedia Subsystem (IMS) roaming over Long Term Evolution (LTE) and LTE-Advanced.

I.11 Working Methods, Rules and Procedures

[**ITU-T A.Suppl.2 (revised) Supplement 2 to the ITU-T A-series Recommendations “Guidelines on interoperability experiments”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?rec=15252) relate to interoperability experiments and proof-of-concept events to be performed outside of ITU-T. The guidelines have been prepared in order to encourage such experiments to be performed and events, and to facilitate information exchange between ITU-T and parties participating in such experiments.

[**ITU-T A.Suppl.4 (revised) Supplement 4 to the ITU-T A-series Recommendations “Guidelines for remote participation”**](https://www.itu.int/ITU-T/recommendations/rec.aspx?id=15253) specifies guidelines on the organization and handling of meetings of ITU-T groups with remote participation.

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