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| 725ITU logo | INTERNATIONAL TELECOMMUNICATION UNION**TELECOMMUNICATIONSTANDARDIZATION SECTOR**STUDY PERIOD 2017-2020 | **TSAG-TD725** |
| **TSAG** |
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| **Question(s):** | N/A | Geneva, 10-14 February 2020 |
| **TD** |
| **Source:** | TSB |
| **Title:** | ITU-T SG and FG work on AI/ML |
| **Purpose:** | Information |
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| **Keywords:** | Artificial Intelligence; AI; Machine Learning; ML; Data; |
| **Abstract:** | This TD is to inform TSAG of the work underway in the various ITU-T Study Groups and Focus Groups on Artificial Intelligence and Machine Learning. |

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| **AI work in ITU-T, status 30 January 2020** |
| **Group** | **AI Work**  | **Comments** |
| SG2 | SG2 consented draft Recommendation [ITU-T M.3041 (ex M.somm)](https://www.itu.int/itu-t/workprog/wp_item.aspx?isn=14196), “Framework of smart operation, management and maintenance” at its meeting in Geneva (4-13 December 2019); artificial intelligence is one of the five characteristics of the new framework. At the same meeting, ITU-T SG2 initiated the following three new work items related to AI:* [ITU-T M.AI-tom](https://www.itu.int/itu-t/workprog/wp_item.aspx?isn=16432), "Framework of AI enhanced Telecom Operation and Management (AI-TOM)".
* [ITU-T M.resm-AI](https://www.itu.int/itu-t/workprog/wp_item.aspx?isn=16435), "Requirements for energy saving management of 5G RAN system with AI".
* [ITU-T M.rrsp](https://www.itu.int/itu-t/workprog/wp_item.aspx?isn=16433), "Requirements for robot-based on-site smart patrol of telecommunication network".
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| SG3 | ITU-T SG3 created new work items in continuation to align technical innovation and policy development. These work items include a Technical Report on the “Future of Regulation for Digital Transformation” and a Technical Paper on “IMT2020-related Policy considering MVNOs”. SG3 has also began working on a proposed new ITU-T Recommendation on “Roaming aspects of IoT and M2M including any related development and tariff principles. |  |
| SG5 | ITU-T SG5 is currently working on the following work item:* [Draft ITU-T L.AI-Env\_effects "AI environmental effect on Networks goods and services"](https://www.itu.int/itu-t/workprog/wp_item.aspx?isn=14879)
* [Draft Recommendation ITU-T L.DCIM "Specifications of data centre infrastructure management (DCIM) system based on Big Data and AI technology"](https://www.itu.int/itu-t/workprog/wp_item.aspx?isn=14873) was consented on 20 September 2019.

A new Focus Group on "Environmental Efficiency for Artificial Intelligence and other Emerging Technologies" was created by SG5 in May 2019 and will hold its first meeting in December 2019 in Vienna, Austria.  |  |
| SG9 | SG9 has approved (2019-10) a new Recommendation (ITU-T J.1600) *“Premium Cable network platform (PCNP*) *– Framework*”, which features an embedded intelligent analyzer and controller for enabling advanced multimedia services to exploit the cloud based artificial intelligence and network data to optimize the network and TV services. This will enhance cable TV user’s experience and satisfaction. SG9 also plans to establish a new dedicated Question to perform AI related studies *“Usages of intelligence functions for video transmission over integrated broadband networks”*. The current draft ToR for the new Question, which plans to be included in SG9 structure in the next Study Period, is found in [SG9 SharePoint](https://extranet.itu.int/meetings/ITU-T/T17-SG09RGM/17486-190904/DOCs/T17-SG09RGM-17486-190904-DOC-0012.docx)  |  |
| SG11 | One of the presentations given at the [SG11 Workshop](https://www.itu.int/en/ITU-T/Workshops-and-Seminars/201711/Pages/default.aspxhttps%3A/www.itu.int/en/ITU-T/Workshops-and-Seminars/201711/Pages/default.aspx) “Control plane of IMT-2020 and emerging networks. Current issues and the way forward” (November 2017) was about [SDN/NFV Network AI Assurance In Practice](https://www.itu.int/en/ITU-T/Workshops-and-Seminars/201711/Documents/3.S2_Rui.pdf). The [outcomes](https://www.itu.int/en/ITU-T/Workshops-and-Seminars/201711/Documents/Outcomes_Workshop_final.pdf) of this event highlights AI as one of the future research activities of SG11 on control plane. Following this workshop, SG11 developed and finally approved Recommendation ITU-T [Q.5001](https://www.itu.int/itu-t/recommendations/rec.aspx?rec=13701) “Signalling requirements and architecture of intelligent edge computing” (October 2018) which specifies signalling requirements and architecture of intelligent edge computing to provide intelligence to the edge network for efficient data processing within the network.In October 2019, SG11 started three new work items on AI:* ITU-T Q.IMT2020-PIAS “Protocol for providing intelligent analysis services in IMT-2020 network” which specifies architecture for supporting intelligent analysis services in IMT-2020 network, and intelligent analysis services offered by Data Analysis Function (DAF) including load balancing, network functions fault location and advance warning, device on/off analysis, mobility analysis, etc.;
* ITU-T Q.INS-PM “Protocol for managing Intelligent Network Slicing with AI-assisted analysis in IMT-2020 network” which describes APIs, API management, message format and procedures related of intelligent network slice with AI-assisted in IMT-2020 networks;
* ITU-T Q.VoLTE-SAO-FP “Framework and protocols for signalling network analyses and optimization in VoLTE”, which defines the framework of signalling network analyses and optimization for VoLTE network, specifies the interfaces and protocols between signalling network analyses and optimization system and VoLTE network, specifies the service procedures of signalling network analyses and optimization, and specifies the AI-assisted functions and security issues of the proposed system.
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| SG12 | Machine learning has become a widely used tool in the context of developing speech, audio and video quality models. Question 14/12 is responsible for the development of models and tools for multimedia quality assessment of packet-based video services. During the development of [Recommendation ITU-T P.1203](https://www.itu.int/rec/T-REC-P.1203) and its extensions in SG12, machine learning – for example in form of Random Forest models – was used for selecting relevant features, feature pooling and as component of an audiovisual quality integration module (Recommendation ITU-T P.1203.3). Similar techniques form the basis of the models developed in the [ITU-T P.1204](https://www.itu.int/rec/T-REC-P.1204) series (Video quality assessment of streaming services over reliable transport for resolutions up to 4K) (4 new Recommendations approved in January 2020, 2 under development targeting completion in April 2020).AI and machine learning play an important role in predicting speech quality. Question 15/12 (Parametric and E-model-based planning, prediction and monitoring of conversational speech quality) completed work on a framework for creation and performance testing of machine learning based models for the assessment of transmission network impact on speech quality for mobile packet-switched voice services – approved in January 2020 as new [Recommendation ITU-T P.565](https://www.itu.int/rec/T-REC-P.565). The work of Question 16/12 (Framework for diagnostic functions) relies on machine learning techniques to perform network anomaly detection and root cause analysis. Related guidelines are described in new [Recommendation ITU-T E.475 “Guidelines for intelligent network analytics and diagnostics,”](https://www.itu.int/rec/T-REC-E.475) approved in January 2020.Some of the lessons learned in the development of the above Recommendations will be presented in the form of a technical report ([TR-ML](https://www.itu.int/itu-t/workprog/wp_item.aspx?isn=14675)) and a supplement ([Suppl.ML](https://www.itu.int/itu-t/workprog/wp_item.aspx?isn=14956)) describing considerations on the use of algorithms based on machine learning and artificial intelligence for QoS and QoE purposes. |  |
| SG13 | Tutorials* On AI, 6 November 2018, 3 presentations;
* WSIS Forum side event, AI talk by FG ML5G chair, 19 March 2018

 Question 17/13 has AI in its description since November 2016 (*Developing Recommendations for emerging cloud and big data technology overview, requirements aspects such as distributed cloud, and cloud/big data to support artificial intelligence including machine learning*).In October 2019 Question 20/13 “*IMT-2020: Network requirements and functional architecture*” up-dated its text to include network intelligence into IMT-2020 standardization. Q20/13 is devoted to the machine learning and beginning of artificial intelligence as applied to networks. Approved Recommendations- ITU-T Y.3170 (2018), *Requirements for machine learning-based quality of service assurance for the IMT-2020 network*- ITU-T Y.3172 (2019), *Architectural framework for machine learning in future networks including IMT-2020,* (based on the FG ML5G Deliverable) andSupplement * Suppl.55 to ITU-T Y.3170-series (2019), *Machine learning in future networks including IMT-2020: use cases*.
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| Work item | Question | Equiv. Num. | Status | Timing | Approval process | Version | Liaison relationship | Subject / Title | Priority |
| Y.qos-ml-arc | Q6/13 |   | Under study | 2020-03 | AAP | New | - | Architecture of machine learning based QoS assurance for the IMT-2020 network | High |
| Y.bDDN-MLMec | Q7/13 |   | Under study | 2021-10 | AAP | New | - | Mechanisms of machine learning for big data driven networking | Medium |
| Y.MecTA-ML | Q7/13 |   | Under study | 2021-07 | AAP | New | - | Mechanism of traffic awareness for application-descriptor-agnostic traffic based on machine learning  | Medium |
| Y.MLN-Fr | Q7/13 |   | Under study | 2021-12 | AAP | New | - | Framework for man-like networking | Medium |
| Suppl on Y. Sup.aisr | Q17/13 |   | Under study | 2020-Q4 | AAP | New | SG16, SG17, SG20, JTC 1/SC 42 | Artificial Intelligence Standard Roadmap  | Medium |
| Y.MLaaS-reqts | Q17/13 |   | Under study | 2020-Q4 | Agreement | New | ITU-T SG16, SG17, SG20, JTC 1 SC 42, ETSI, IEEE | Cloud computing - Functional requirements for machine learning as a service | Medium |
| Y.3173 (ex Y.ML-IMT2020-Intelligence) | Q20/13 |   | Consented 2019-10-25 | 2020-03 | AAP | New | ETSI ENI ISG | Framework for evaluating intelligence levels of future networks including IMT-2020 | Medium |
| Y.3174 (ex Y.ML-IMT2020-Data-Handling) | Q20/13 |   | Consented 2019-10-25 | 2020-03 | AAP | New | ITU-T SG 11 | Framework for data handling to enable machine learning in future networks including IMT-2020 | Medium |
| Y.IMT2020-AIICDN-arch | Q20/13 |   | Under study | 2021-12 | - | New | ETSI, 3GPP, ITU-T SG11 | AI integrated cross-domain network architecture for future networks including IMT-2020 | Medium |
| Y.ML-IMT2020-NA-RAFR | Q20/13 |   | Under study | 2020-Q2 | - | New | ETSI, 3GPP, TMF | Architecture framework of AI-based network automation for resource adaptation and failure recovery for future networks including IMT-2020 | Medium |
| Y.ML-IMT2020-serv-prov | Q20/13 |   | Under study | 2020-Q2 | - | New | ETSI, 3GPP, TMF | Architecture framework of user-oriented network service provisioning for future networks including IMT-2020 | Medium |
| Y.ML-IMT2020-MP | Q20/13 |   | Under study | 2020-Q2 | - | New | ETSI, 3GPP | ML marketplace integration in future networks including IMT-2020 | Medium |
| Y.IMT2020-NSAA-reqts | Q21/13 |   | Under study | 2020-07 | AAP | New | - | Requirements for network slicing with AI-assisted analysis in IMT-2020 networks | High |

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| SG15 | Seven Contributions were submitted to the SG15 meeting in Jan/Feb 2020 on AI/ML for transport network including a New Work Item proposal. |  |
| SG16 | New Question 5/16 (under review)Artificial intelligence-enabled multimedia applications – ToR: <http://itu.int/en/ITU-T/studygroups/2017-2020/16/Pages/q5.aspx>; Click [here](https://www.itu.int/ITU-T/workprog/wp_search.aspx?isn_sp=3925&isn_sg=3934&isn_qu=7955&isn_status=-1,1,3,7,2&details=0&field=acdefghijo) for work programme updates.. |  |
| Focus Group on AI for health (FG-AI4H)The ITU-T Focus Group on Artificial Intelligence for Health ([FG-AI4H](https://www.itu.int/en/ITU-T/focusgroups/ai4h/Pages/default.aspx)) was established by ITU-T Study Group 16 at its meeting in Ljubljana, Slovenia, 9-20 July 2018. In partnership with the World Health Organization (WHO), the Focus Group is working to establish a standardized assessment framework for the evaluation of AI-based methods for health, diagnosis, triage or treatment decisions. The home page is: <https://itu.int/go/fgai4h>.Within the FG-AI4H a range of [topics](https://www.itu.int/en/ITU-T/focusgroups/ai4h/Pages/tg.aspx) are being worked on: * Cardiovascular disease risk prediction (TG-Cardio)
* Dermatology (TG-Derma)
* Falls among the elderly (TG-Falls)
* Histopathology (TG-Histo)
* Malaria detection (TG-Malaria)
* Neurological disorders (TG-Neuro)
* Ophthalmology (TG-Ophthalmo)
* Outbreak detection (TG-Outbreaks)
* Psychiatry (TG-Psy)
* Snakebite and snake identification (TG-Snake)
* Symptom assessment (TG-Symptom)
* Tuberculosis (TG-TB)
* Volumetric chest computed tomography (TG-DiagnosticCT)
* *Primary and secondary diabetes prediction (TG-Diabetes)*
* *Diagnoses of bacterial infection and anti-microbial resistance (AMR) (TG-Bacteria)*
* *Dental diagnostics and digital dentistry (TG-Dental)*
* *AI-based detection of falsified medicine (TG-FakeMed)*
* *Maternal and child health (TG-MCH)*
* *Radiotherapy (TG-Radiotherapy)*

An [article](https://www.sciencedirect.com/science/article/pii/S0140673619307627) on the FG-AI4H was published in the Lancet in July 2019. A list of planned deliverables is found in doc. [FG-AI4H-H-200](https://extranet.itu.int/sites/itu-t/focusgroups/ai4h/docs/FGAI4H-H-200.docx).Workshops on artificial intelligence for health organized / planned by the FG:* Geneva, Switzerland, 25 September 2018 – <https://itu.int/en/ITU-T/Workshops-and-Seminars/20180925>
* New York, USA, 14 November 2018 – <https://itu.int/en/ITU-T/Workshops-and-Seminars/20181114>
* Lausanne, Switzerland, 22 January 2018 – <https://itu.int/en/ITU-T/Workshops-and-Seminars/20190122>
* Shanghai, China, 2 April 2019 – <https://www.itu.int/en/ITU-T/Workshops-and-Seminars/ai4h/20190402>
* Geneva, Switzerland, 29 May 2019 (collocated with AI for Global Good Summit) – <https://www.itu.int/en/ITU-T/Workshops-and-Seminars/ai4h/20190529>
* Zanzibar, Tanzania, 2 September 2019 – [https://www.itu.int/en/ITU-T/Workshops-and-Seminars/ai4h/201909](https://www.itu.int/en/ITU-T/Workshops-and-Seminars/ai4h/201909/Pages/default.aspx)
* New Delhi, India, 11-12 November 2019 – https://www.itu.int/en/ITU-T/Workshops-and-Seminars/ai4h/201911/
* Brasilia, Brazil, 21 January 2020 – <https://www.itu.int/en/ITU-T/Workshops-and-Seminars/ai4h/202001/>

Focus Group on AI for autonomous and assisted driving (FG-AI4AD)Created under ITU-T SG16 in October 2019, the ITU-T Focus Group on AI for autonomous and assisted driving ([FG-AI4AD](https://www.itu.int/en/ITU-T/focusgroups/ai4ad/Pages/default.aspx)) supports standardization activities for services and applications enabled by AI systems in autonomous and assisted driving. The FG-AI4AD will focus upon the behavioural evaluation of AI responsible for the dynamic driving task of a vehicle, in accordance with the 1949 and 1968 Convention on Road Traffic of the UNECE Global Forum for Road Safety. To build public trust it is fundamental that the performance of AI on our road meets, or exceeds, the performance of a competent and careful human driver. The FG aims to facilitate international harmonisation on the definition of a minimal performance threshold for these AD vehicles .The FG-AI4AD held its first meeting in London, 21-22 January 2020. More information [here](https://extranet.itu.int/sites/itu-t/focusgroups/ai4ad/SitePages/Home.aspx).Workshops on AI for Autonomous and Assisted Driving related / organized / planned by the FG:* Budapest, Hungary, 10 September 2019 – ITU Workshop on “[**The Turing Test for Autonomous Driving - A Global Performance Standard for AI on our Roads**](https://www.itu.int/en/ITU-T/Workshops-and-Seminars/092019/Pages/default.aspx)“
* London, United Kingdom, 21 January 2020 – ITU Workshop on “[Explainable AI (XAI) for Autonomous and Assisted Driving](https://www.itu.int/en/ITU-T/Workshops-and-Seminars/20200121/Pages/default.aspx)”
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|  | **AI-related topics in SG16 (under study)** |
| **Work item** | **Question** | **Status** | **Approval process** | **Subject / Title** |
| [F.AI-DLFE](http://www.itu.int/itu-t/workprog/wp_item.aspx?isn=15296) | Q5/16 | 2021 | AAP | Deep Learning Software Framework Evaluation Methodology |
| [F.AI-DLPB](http://www.itu.int/itu-t/workprog/wp_item.aspx?isn=15295) | Q5/16 | 2021 | AAP | Metrics and evaluation methods for deep neural network processor benchmark |
| [F.AI-MLTF](http://www.itu.int/itu-t/workprog/wp_item.aspx?isn=15262) | Q5/16 | 2021 | AAP | Technical framework for shared machine learning system |
| [F.AI-SCS](http://www.itu.int/itu-t/workprog/wp_item.aspx?isn=16381) | Q5/16 | 2021 | AAP | Use cases and requirements for speech interaction of intelligent customer service |
| [F.SCAI](http://www.itu.int/itu-t/workprog/wp_item.aspx?isn=15294) | Q5/16 | 2021 | AAP | Requirements for smart class based on artificial intelligence |
| [FSTP-ACC-AI](http://www.itu.int/itu-t/workprog/wp_item.aspx?isn=15037) | Q26/16 | 2020 | Agreement | Guideline on the use of AI for ICT accessibility |
| [H.AI-SaMD-Req](http://www.itu.int/itu-t/workprog/wp_item.aspx?isn=16376) | Q28/16 | 2020 | AAP | Requirements for artificial intelligence/machine learning (AI/ML)-based software as a medical device (SaMD) |
| [H.CUAV-AIF](http://www.itu.int/itu-t/workprog/wp_item.aspx?isn=14760) | Q21/16 | 2020 | AAP | Framework and requirements for civilian unmanned aerial vehicle flight control using artificial intelligence |
| [F.EMO-NN](http://www.itu.int/itu-t/workprog/wp_item.aspx?isn=15026) | Q24/16 | 2020 | AAP | Emotion enabled multimodal user interface based on artificial neural network |
| [F.VS-AIMC](http://www.itu.int/itu-t/workprog/wp_item.aspx?isn=14767) | Q27/16 | 2020 | AAP | Use cases and requirements for multimedia communication enabled vehicle systems using artificial intelligence |
| [HSTP.Med-AI-CCTA](http://www.itu.int/itu-t/workprog/wp_item.aspx?isn=16378) | Q28/16 | 2020 | AAP | Guidelines on development and application of artificial intelligence in coronary computed tomography angiography |
| [F.IQAS-INT](http://www.itu.int/itu-t/workprog/wp_item.aspx?isn=15015) | Q21/16 | 2020 | AAP | Interfaces for intelligent question answering system |
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| **AI-related topics in SG16 (completed)** |
| **Work item** | **Q** | **Timing** | **Approval process** | **Subject / Title** |
| [F.746.7](http://www.itu.int/itu-t/workprog/wp_item.aspx?isn=14066) | Q21/16 | 2018 | AAP | Metadata for intelligent question answering service |
| [H.626.5](http://www.itu.int/itu-t/workprog/wp_item.aspx?isn=13292) | Q21/16 | 2019 | AAP | Architecture for intelligent visual surveillance systems |
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| SG17 | SG17 is organizing a workshop on AI/ML and security on 21 Jan 2019 prior to next SG17 meeting, see <https://www.itu.int/en/ITU-T/Workshops-and-Seminars/20190121/Pages/default.aspx>. Q2/17 Question text was updated (pending TSAG endorsement, TSAG-[TD511](https://www.itu.int/md/T17-TSAG-190923-TD-GEN-0511/en)) to include study of ‘foundations of artificial intelligence (AI) / machine learning (ML) in supporting the building of confidence and security in the use of ICT’.Q5/17 established a new work item TR.cs-ml “Technical Report: Countering spam based on machine learning” in SG17 Sept 2019 meeting. |
| SG20 | SG20 is currently working on AI and machine learning issues especially in Q3/20, Q4/20 and Q5/20. For example the following work items are being developed: * [Draft ITU-T Y.SSC-AISE-arc "Reference architecture of artificial intelligence service exposure for smart sustainable cities"](https://www.itu.int/ITU-T/workprog/wp_item.aspx?isn=14503)
* [Draft Technical Report – TR.AI4IoT "Unlocking Internet of things with artificial intelligence: Where we are and where we could be"](https://www.itu.int/ITU-T/workprog/wp_item.aspx?isn=14103)

SG20 collaborates closely with oneM2M and address issues including on IoT and machine learning matters. Information on the work carried out in other SDOs and fora, *inter alia,* on AI and machine learning is being shared in the [Joint Coordination Activity on Internet of Things and Smart Cities and Communities (JCA-IoT and SC&C)](https://www.itu.int/en/ITU-T/jca/iot/Pages/default.aspx). The next meeting will take place December 2019, Geneva, Switzerland.

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| **Reference** | Title | Status |
| [ITU-T Y.SSC-AISE-arc] | Reference architecture of artificial intelligence service exposure for smart sustainable cities | 4Q 2020 |
| [ITU-TY.Sup.AI4IoT] | Unlocking Internet of things with artificial intelligence: Where we are and where we could be | 2Q 2020 |
| [ITU-TY.IoT-LISF] | Lightweight intelligent software framework for IoT devices | 2Q 2020 |

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| FG DPM | None |
| FG DFC | None |
| FG 5GML | <https://www.itu.int/en/ITU-T/focusgroups/ml5g/Pages/default.aspx> The Focus Group will draft technical reports and specifications for machine learning (ML) for future networks including 5G, with focus on network architectures, interfaces, protocols and data formats.Previous meetings: <https://www.itu.int/en/ITU-T/focusgroups/ml5g/Pages/past.aspx> :1st meeting: Geneva, 30 January - 2 February 2018**2nd** meeting: Xi'an, China 24, 26 - 27 April 20183rd meeting: San Jose, USA 8-10 August 2018 , hosted by Intel4th meeting: Tokyo, 27-29 November 20185th meeting: Shenzhen, China, 5, 7-8 March 20196th meeting: Geneva, Switzerland 18-20 June 2019 Upcoming meeting:7th meeting: Berlin, Germany, ​ 6-8 November 201Workshops:* [Workshop on Machine Learning for 5G and beyond](https://www.itu.int/en/ITU-T/Workshops-and-Seminars/20180129/Pages/default.aspx), 29 January 2018
* [Workshop on Impact of AI on ICT Infrastructures, 25 April 2018](https://www.itu.int/en/ITU-T/Workshops-and-Seminars/20180425/Pages/default.aspx)
* [Workshop on Machine Learning in 5G and beyond](https://www.itu.int/en/ITU-T/Workshops-and-Seminars/20180807/Pages/default.aspx), 7 August 2018 (hosted by Intel)
* [Seminar on "Business innovation and value creation utilizing IoT/AI"](https://www.itu.int/en/ITU-T/focusgroups/ml5g/Documents/Seminar_program_26Nov2018.pdf), 26 November 2018
* [Workshop on Towards a New Era - AL in 5G](https://www.itu.int/en/ITU-T/Workshops-and-Seminars/201903/Pages/default.aspx), 6 March 2019
* [Workshop on Machine Learning for 5G and beyond​](https://www.itu.int/en/ITU-T/Workshops-and-Seminars/20190617/Pages/default.aspx), 17 June 2019 ​​​​
* [Workshop "Machine Learning for 5G".](https://www.itu.int/en/ITU-T/Workshops-and-Seminars/201911/Pages/default.aspx) Berlin, Germany, 5 November 2019
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| U4SSC  | U4SSC is developing a series of reports on:* "The Impact of Frontier Technologies in Cities (with a special focus on AI and ML in cities)"
* The impact of Sensing technologies and IoT in Cities
* The impact of Artificial Intelligence and Cognitive Computing in Cities
* The impact of Data Processing and Computation in Cities
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| FIGI SIT WG | FIGI Security, Infrastructure and Trust WG (SIT WG) is developing a report on the Data Privacy and risks for consumer protection due to emerging technologies such as big data and machine learning. |
| ITU | AI for Good event (-2017, -2018, -2019); upcoming Summit: 4-8 May 2020 |

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