ITU REVIEWS 2021
(PART 2. THEMATIC BACKGROUNDERS)

The International Telecommunication Union (ITU) is the United Nations specialized agency for information and communication technologies (ICTs), driving innovation in ICTs together with 193 Member States and a membership of over 900 companies, universities, and international and regional organizations. Established over 150 years ago in 1865, ITU is the intergovernmental body responsible for coordinating the shared global use of the radio spectrum, promoting international cooperation in assigning satellite orbits, improving communication infrastructure in the developing world, and establishing the worldwide standards that foster seamless interconnection of a vast range of communications systems. For more information, visit www.itu.int.

ACCESSIBILITY TO ICTS

OVERVIEW

• Given the growing proliferation of devices in our lives, it is vital that persons with disabilities (PwDs) or rare diseases can fully access Information and Communication Technologies (ICTs) and the opportunities they provide in their own right. Digital accessibility is key to ensuring respect for everyone's right to be able to participate in an interconnected world, as it enables digital inclusion and inclusive discourse for all people - regardless of age, gender, ability, or location.

• Common examples of accessibility features include: voice-to-text conversion (captioning), automated sub-titles and sign language for the deaf or hard of hearing and expandable font sizes.

• ICTs also offer hope for improving quality of life and social inclusion for Persons with Disabilities now and in the future, including: brain-to-machine interfaces, self-directed mobility aids and autonomous cars.

• The World Bank estimates that one billion people suffer from some sort of disability. By 2030, the number of senior citizens aged 60 and above who face age-related disabilities is expected to reach 1.4 billion, rising to 2.1 billion by 2050 [1]. Moreover, 1.1 billion youth are in danger of experiencing some form of hearing loss due to their unsafe listening habits[2]. Given these figures, within thirty years, half of the world's population could be affected by some form of disability.

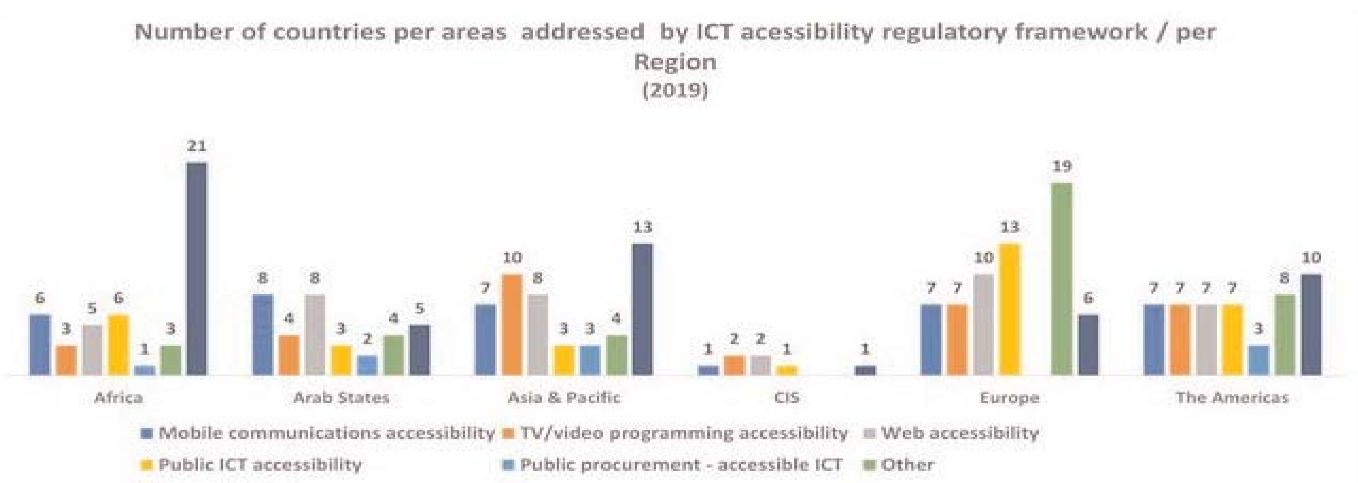
• Persons with Disabilities can suffer from a wide range of conditions, from congenital conditions to specialized needs brought about by rare diseases, injuries inflicted though accident or illness, impairments to sensory or perception loss or age-related illnesses. Private companies may not voluntarily include accessibility features in their products and services, so there is a strong role for Government policy to ensure accessibility of services, as well as technical standards to ensure accessibility is taken into account in the design of technological products and services.

CHALLENGES

An estimated one billion persons live with disabilities, of which 80% live in developing nations, where infirmity and disabilities are real drivers of exclusion and poverty. The WHO estimates that, globally, the number of people with visual impairments is around 285 million, of whom 39 million are blind, with people over 50 years old accounting for 82% of all blind people [3]. WHO also estimates there are 466 million persons with disabling hearing loss, some 6.1% of the global population [4].

Article 9 of the UN Convention on the Rights of Persons with Disabilities (PwDs) defines ICT accessibility as an integral part of accessibility rights, on a par with transport and the physical environment[5]. A multi-stakeholder coalition of partners including ITU and the UN Broadband Commission for Sustainable Development has stated that "no one should be excluded from using mobile phones, the Internet, televisions, computers, electronic kiosks and their myriad of applications and services including in education, political life, and cultural activities or for e-government or e-health to cite a few examples. Being excluded from ICT-enabled applications implies being shut out from the information society, as well as from accessing essential public services and the opportunity of living an independent life" [6].

Furthermore, digital accessibility is recognized as a key priority in various global commitments related to inclusiveness, such as: the Convention on the Rights of Persons with Disabilities (CRPD), the 2030 Agenda, the Sustainable Development Goals (SDGs) and the UN Disability Inclusion Strategy.



SOLUTIONS

Making ICTs and ICT services accessible is not just a human rights issue or a question of justice and equality of access to communications, information, and opportunities for all. ICTs can make a very real difference to the quality of life of people living with difficult or debilitating conditions or disabilities. Examples include:

• Voice-to-text conversion for the hard-of-hearing.

• Expandable font sizes or text-to-voice conversion for people with deteriorating or failing and degraded eyesight.

• Warning, space, and motion sensors for people with poor or limited sight.

• Digital libraries for deaf persons or hard of hearing.

• Global Positioning System (GPS) navigation for people with location amnesia.

• Photo albums or voice recordings for people with amnesia, dementia, or short-term memory loss, to remind them of their past and the identity of friends and relatives.

• The prospect of independent mobility via autonomous and self-driving cars for blind persons or people with poor eyesight.

• Machines to produce speech for people with e.g. motor neurone disease, who are no longer able to speak.

Some neurological problems that people experience-including some types of memory loss, depression, blindness, and seizures, to name a few-are the result of erratic or absent electrical signals in parts of the brain. Various research projects are underway on brain-machine interfaces.

ITU'S CONTRIBUTION

The ITU Plenipotentiary Conference 2018 renewed ITU's mandate in the area of ICT accessibility, inITU Resolution 175 (Rev. 2018) on "Telecommunication/ICT accessibility for persons with disabilities and persons with specific needs". It also approved the Connect 2030 Agenda, which sets out the vision, goals and targets that ITU and its Member States have committed to achieve by 2023. All three ITU Sectors have approved specific resolutions on accessibility at their respective Conferences[7].

ITU's Member States are fully committed to advancing ICT accessibility implementation in their countries and regions. The Connect 2030 Agenda includes a bold target directed at cultivating government commitment to make the ICT sector inclusive of persons with disabilities and specific needs. Target 2.9: Enabling environments ensuring accessible telecommunication/ICT for persons with disabilities should be established in all countries by 2023.

ITU has developed a series of resources to support ITU Member States in creating enabling environments ensuring accessible telecommunication/ICT for PwDs, and in building inclusive digital societies in their countries and regions. According to ITU's latest data, by 2019, 84 countries had established a regulatory framework to ensure ICT accessibility for persons with disabilities (Figure below). Regulatory frameworks can include accessibility requirements for: mobile communications; web accessibility; public procurement of accessible ICT; TV or video programming; and public ICT accessibility, as well as other areas.

ITU's Standardization Sector (ITU-T) develops international standards known as ITU-T Recommendations. Its work on accessibility started in the early 1990s with ITU-T V.18 text telephone. Since then, a number of ITU standards on accessibility have been developed within ITU-T SG16, Question 26/16 on accessibility and Question 24/16 on human factors and cooperated with advocacy organizations (such as the G3ict, WFD and RNIB), in addition to other technical groups such as ITU-T, D, R Study Groups and ISO/IEC JTC1 SC35. A sample of which is found in the ITU-T Accessibility and Standardization.

Recently approved ITU-T Recommendations on accessibility include:

• ITU-T F.791 (08/2018) provides accessibility terminology and terms with definitions harmonized with UN CRPD definitions.

• ITU-T F.921 (08/2018) describes how audio-based network navigation systems can be designed to ensure that they are inclusive and meet the needs of persons with visual impairments.

• ITU-T F.930 (03/2018) describes functional description of four common types of relay services in use today: text relay; video relay; captioned telephone service relay; speech-to-speech relay.

• ITU-T H.702 (11/2015) defines the basic functions of accessibility services on IPTV.

• H.871(07/2019) provides characteristics of Personal Sound Amplifiers and suggests ways of informing consumers about the potential unacceptable noise levels when using these devices for prolonged periods of time.

• ITU-T Y.4204 (02/19) (ITU-T SG20) provides accessibility requirements for the Internet of Things (IoT) applications and services.

ITU-T also produces various Technical Papers on accessibility:

• FSTP-ACC-RCS (2018) provides introduction to remote captioning services, with background, technical, security and quality aspects.

• FSTP-ACC-RemPart (2015) provides guidelines to ensure that remote participation in meetings is accessible for persons with disabilities.

• FSTP-TACL (2006) provides checklist to ensure accessibility of specified services and features from the beginning of standards development process.

ITU's Development Sector (ITU-D) work in ICT accessibility supports the advancement of the global disability-inclusive agenda and the development of inc lusive digital communities. ITU-D helps raise awareness, build capacity and provide policy and strategy advice to ITU members. ITU-D has helped countries by implementing regional initiatives and activities linked to ICT accessibility in the Africa, Americas, Arab, Asia and Pacific European and CIS regions, through direct assistance to countries, development and provision of relevant guidelines, development and delivery of on-line and face-to-face trainings, toolkits, and reports, and by facilitating joint working platforms such as Study Group and regional "Accessible-ICT for ALL" knowledge development forums enabling stakeholders to share good practices and engaging in national and regional digital accessibility implementation. Finally, ITU-D is supporting members' efforts in mainstreaming digital accessibility to ensure the full and effective participation of everyone in the digital economy by developing and making available a series of useful resources.

AFFORDABILITY

OVERVIEW

The price of telecommunication and Internet services is regularly cited as one of major barriers to Internet access and usage. Monitoring prices is very difficult, as prices depend on: type of service (fixed versus mobile); bundling of different services; different operators (within the same market); data, voice and text allowances; and whether national or international comparisons are made.

There is evidence to suggest that affordability or the ability of individuals or households to pay for telecom services relative to their disposable income is one of the main barriers that affect consumer consumption of Internet services. Affordability depends not only on both price and income, but also on other, competing spending choices available.

Globally, prices for voice and data services have been falling over the last decade, in line with growing competition and strong increases in subscriber rates and usage.

ITU is the official source for global ICT data and statistics, including ICT price data. ITU has the responsibility for collection and reporting of global and national official telecommunication statistics as well as statistics for ICT household access and individual ICT use within the UN system. ITU works with other international organizations (e.g. the World Bank and OECD) to ensure the accuracy and international comparability of these data. ITU was a founding member of the Partnership on Measuring ICT for Development.

ITU monitors price data from ITU Member States via an annual survey, which are disseminated in the World Telecommunication/ICT Indicators Database and the ITU Yearbook of Statistics.

ITU also tracks the Connect 2030 Agenda, a set of indicators agreed by ITU membership, which includes affordability indicators and targets.

DEFINING PRICE VERSUS AFFORDABILITY

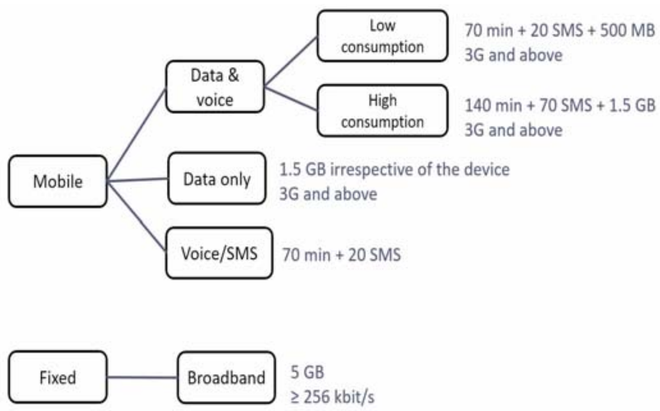
Defining the 'affordability' of telecom services can be very hard. This question can be answered statistically in different ways, depending on whether we examine:

- Direct comparisons between different operators in a single country or over time. Prices can vary due to: contract length; volume of minutes; texts and data allowances; and whether a handset is included.
- International comparisons: may require adjustments for exchange rates and purchasing power parity between different countries.

Standardized price baskets can be used to compare prices between operators and/or countries. Prices significantly influence the profitability of mobile operators, and their ability to survive, upgrade and reinvest in networks. Prices for initial service launches may be high ('premium pricing'), but usually fall as services are rolled out across larger subscriber bases (sometimes due to 'economies of scale' or 'predatory pricing'), sometimes resulting in lower prices for larger operators, with larger subscriber bases.

The 'price' of telecom/ICT services is often cited as a barrier to using telecom services, but there is evidence that what really matters is the 'affordability' or ease of purchasing a service, relative to consumer income. Prices can be expressed as a percentage of Gross National Income (GNI) per capita to show prices relative to the size of the economy of each country, thus pointing to the affordability of each ICT service at country level. Such national averages may not indicate that ICT services are affordable for poorer social classes, or any particular household or individual, but they still give insights into whether telecom services are affordable.

ITU has defined a number of price baskets:



Baskets provide a helpful standard benchmark for comparisons, but they have some drawbacks: there are many other packages available to consumers; they may not take account of the evolving consumer behavior over time; and they use a 'weighted average' price, irrespective of number of subscribers that use it.

For affordability, ITU monitors countries where low-consumption data and telecom services are affordable. There is still a small number of countries where data and telecom services are relatively unaffordable, costing above 10% of GNI per capita.

CHALLENGES

In 2018, the ITU/UNESCO Broadband Commission for Sustainable Development set out a target for 2025 that entry-level broadband services should be made affordable in developing countries, defined as <2% of monthly GNI per capita.

The lack of internationally comparable data makes it hard to assess the impacts of price bundling on consumer welfare, competition, and universal broadband access. Comparable data is needed, to enable regulators and consumers to compare prices and identify trends. ITU works closely with other regional and international bodies (including the UN, Eurostat, OECD and the Partnership on Measuring ICT for Development and country experts) on developing international definitions, standards and methodologies for telecommunication/ICT data.

The telecom/ICT sector is very complex, with many converged services. Historically, prices used to be paid and settled on the basis of per minute charges or tariffs. Today, however, many operators have moved to Internet Protocol (IP)-based networks and now price their communication services on a 'flat-rate' basis, for a certain amount of data. This relates to the consumption of services (e.g. movies, online games) for large amounts of data.

For mobile services, prices vary hugely between a pre-paid or basic entry package and more sophisticated packages. Prices may also vary 'on-net' and 'off-net'.

It can be difficult for consumers to compare the prices for different packages for even a single operator, at any point in time, with the ultimate price often depending on usage patterns among consumers (e.g. many operators offer free calls to 'favorite contacts'/friends & family and/or multiple phones linked with one household.

OPPORTUNITIES

Falling prices have been linked to increased subscription rates and greater usage of ICT services. Different stakeholders have a different role to play. Telecom operators have a vital role in defining, revising and pricing telecom packages for consumers – in terms of monthly subscription prices or prices per traffic. Historically, there is strong evidence to suggest that prices in mobile markets generally fell, following the introduction of strong and effective competition with alternative mobile operators.

ICT regulators often set reference interconnection offers, setting recommended or ceiling interconnection prices between operators (for example, this is what the Nepalese regulator has just done[i]). They often also set national benchmark prices and monitor markets through regular market surveys, to try and define, and ensure 'fair' and affordable prices for consumers, against fair returns for operators, so they can continue to invest and upgrade mobile networks.

Governments (Ministries and regulators) can also play a strong advocacy role, by signaling the importance of advanced 4G and 5G infrastructure at the national level (e.g. through a 5G Action Plan, Digital Agenda or other statement of policy). They can also convene dialogues and national consultations to define national priorities for the rollout of advanced digital infrastructure among different stakeholders.

ITU'S ROLE

ITU holds various responsibilities for data and statistics in the international system. At the 2014 Plenipotentiary Conference in Busan, Rep. of Korea, ITU membership agreed on the Connect 2020 Agenda, revised at the 2018 Plenipotentiary Conference to the Connect 2030 Agenda, containing various targets, to monitor progress towards a set of key indicators.

ITU has the reporting responsibility for formal collection and reporting of global and national official data and statistics for telecommunication/ICT within the UN system, and provides these data to international organizations (e.g. World Bank) and outside (e.g. the World Economic Forum, Internet World Stats and Statista).

ITU carries out annual collections of: (1) telecommunication/ICT data from national telecommunication/ICT ministries and regulatory authorities on fixed-telephones, mobile-cellular services, Internet/broadband subscriptions, traffic, prices, revenues and investment; and (2) household ICT data, covering access to ICTs by households and use of ICTs by individuals, generally from national statistical offices (NSOs).

ITU-T Study Group 3 is responsible for "tariff and accounting principles including related telecommunication economic and policy issues" and fosters collaboration among ITU members in the interests of establishing telecom rates as fair and as low as possible.

ITU is the custodian of a number of SDG indicators (4.4.1, 5.b.1, 9.c.1, 17.6.2 and 17.8.1) and responsible for tracking them at the international level. These do not directly include price, but recognize the need for affordable Internet access.

ITU regularly hosts the "World Telecommunication/ICT Indicators Symposium" (WTIS) to discuss the latest key issues in the field of ICT statistics.

ARTIFICIAL INTELLIGENCE FOR GOOD

OVERVIEW

Artificial Intelligence (AI) comprises a rich set of methods and disciplines, including vision, perception, speech and dialogue, decisions and planning, problem solving, robotics and other applications that enable self-learning. AI is best viewed as a set of technologies and techniques used to complement traditional human attributes, such as intelligence, analytical ability and other capabilities.

ITU is engaged in a body of work about how AI can influence telecommunication and radiocommunication networks, as well as the broader information and communication technology (ICT) environment.

A robust enabling environment is necessary for driving innovation and trusted use of AI technologies. Development of policy must take into account the needs of specific user groups to avoid discrimination and ensure that everyone can experience the benefits of AI (including poorer communities, children, persons with disabilities and indigenous peoples).

Artificial Intelligence (AI) comprises a set of widely different technologies, which can be broadly defined and grouped together as 'self-learning, adaptive systems'. There are various approaches to defining AI:

In terms of technologies, techniques and/or approaches (e.g., a neural network approach to machine translation);

In terms of purpose (facial recognition, image recognition). In terms of functions (e.g., the ability to understand language, recognize pictures, solve problems, and learn, according to the Cambridge Dictionary). In terms of agents or machines or algorithms (e.g., robots, self-driving cars).

AI comprises a rich set of methods and disciplines, including vision, perception, speech and dialogue, decisions and planning, problem-solving, robotics and other applications that enable self-learning. AI is best viewed as a set of technologies and techniques used to complement traditional human attributes, such as intelligence, analytical ability and other capabilities. AI, Machine Learning (ML) and modern data techniques have been greatly enabled by recent advances in computer processing, power and speed, and advances in AI depend in turn on advances in data techniques.

OPPORTUNITIES

Across many sectors, AI offers advantages of new and innovative services, and the potential to improve scale, speed and accuracy. AI extends and combines many of these advantages with insights from statistics and big data. Based on trend analysis, AI helps move business and policy models and regulatory approaches from descriptive analysis and trendspotting to more sensitive, proactive predictive and evidence-based models and approaches. For example, AI is being used to spot patterns in health vulnerabilities and insurance risks, among many other applications.

The use of AI tools and techniques is driving new opportunities across many diverse domains. AI and other algorithms are used extensively in online search, entertainment, social media, self-driving cars, visual recognition, translation tools, smart assistants/speakers, voice-to-text and many other applications.?

CHALLENGES

Policy and regulatory frameworks for AI remain at an initial, formative stage. Key policy questions that have arisen relate to:

- Use, accuracy and methods used by AI tools, including in relation to humans, including the development of bias in machine learning models and the data used to train them;
- Accountability and responsibility accompanying the use of AI models;
- Purposes for which they are used as well as datasets used to train them, and the methods used to collect (or 'scrape') data.

Major questions arise in relation to the quality and representativeness of the datasets that have been used to train AI. Researchers are also working to improve the accuracy of software tools and algorithms, amid concerns they magnify racial and socioeconomic biases. For example, while the COVID-19 pandemic has, in many countries, disproportionately affected minorities, AI-based prediction models may not always include other relevant health disparities and thus may not always correctly assess risks for each person or group.

Data ownership has emerged as a major issue. Data must be continually aggregated to help keep every model valid, accurate and effective in predicting outcomes. There is an increasing proliferation of deep fakes (e.g. convincing programmed videos of high-profile personalities saying or doing things the video creator has requested) and other AI-generated materials. Indeed, deep fake technologies have been used to generate misleading videos in the mainstream media, as well as to animate photos of long-dead celebrities. Aside from crucial ethical questions about use and accuracy, who owns the copyright to these “new" works?

AI has extraordinary potential to act as a force for good. However, considerable challenges persist:

- Fundamental trust and the transparency of models: It is frequently unclear how deep learning models arrive at their conclusion and the models may be opaque and not very transparent. Depending on the purpose, although researchers want AI to make accurate predictions, some researchers may still prefer simple yet explainable AI models to more accurate, but more opaque models. Some people are willing to 'trust' machines with complex systems and tough decisions, while others may fundamentally prefer to retain some degree of human involvement.
- Bias: While AI can be used for extremely useful purposes, it can also inadvertently generate poor or inappropriate purposes or unintended outcomes. There is growing concern about issues of racial, disability and gender bias in AI and machine learning algorithms, and their wider impact on society at large. The accuracy of an AI ML model depends on the quality and the amount of data that an AI model is trained on. In real life, data is often poorly labelled. Standardization of data sets is needed. Data are also often biased. Training courses on the ethical applications of AI are needed, and not just for computer engineering students.
- Data availability and ownership: Getting data is very difficult. Best practices need to be defined under which circumstances data can be made available and to whom, whilst respecting ownership and explicit promises of confidentiality for certain types of data.
- Data privacy and security: Security breaches due to cyber-attacks can have horrific consequences. Techniques such as federated learning can reduce the risks by enabling AI models to be trained across devices that hold data locally, without exchanging them, while privacy-preserving technologies help ensure personal data protection.
- Limited know-how: AI can tackle many problems, but there is only a limited pool of experts who know how to apply AI ethically. Many researchers point to the need to involve sociologists and policy-makers in discussions, rather than assume that AI designed by a narrow pool of 'technologists', computer engineers and data scientists will be used ethically. Education is key to learn about the responsible use of AI.
- Equitable uses of AI: AI research is computationally intensive. Unequal access to computing power and to data deepens the divide between a few companies and elite universities which do have resources, and the rest of the world which does not.

THE POTENTIAL OF AI TO BE USED FOR GOOD

AI has many important applications to help accelerate progress towards achieving the UN's Sustainable Development Goals (SDGs). AI makes new services possible in many domains important for the SDGs – for example:

In healthcare for SDG3, AI is being used to help offer remote health checks and follow-up tools. AI can analyse large amounts of data to bring together insights from across large populations of patients, improving diagnosis and predictive analysis. AI has been applied with some success to models for diagnosing COVID from lung scans and imagery, or to diagnosing the 'COVID' cough from other types of coughs. AI and big data have the potential to improve healthcare systems by optimizing workflows in hospitals, providing more accurate diagnoses, optimizing clinical decision-making and bringing better treatments and higher-quality care at a lower cost.

AI BCKGROUNDER

In education for SDG4, AI is being used to monitor pupils' attention or to carry out emotional surveillance to determine how comfortable children are learning certain subjects, identifying students who are struggling before their test results become available. In many countries, AI is being used to develop personalized testing tools, to identify areas of weakness and help students improve.

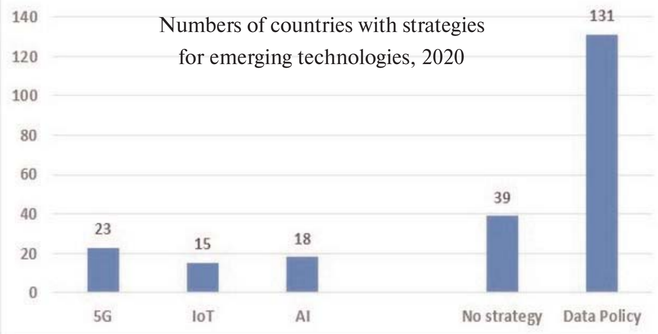
In finance, AI commonly provides insights and assistance with accounting and investment work, including automating routine tasks and uncovering new data patterns that could help with micro-investments to combat poverty (SDG1) or introduce new financial services and infrastructure (SDG9).

In manufacturing, industry and sustainable economic growth (SDG8), the use of automation, fifth generation (5G) mobile telephony, the Internet of Things (IoT) and more extensive robotics has transformed factories, supply depots and warehouses throughout Asia and Europe and the Americas, enabling more efficient and effective manufacturing, production and distribution.

Online translation and publishing software has transformed online publishing, media, and the distribution of text and materials, including books and websites. Many industries now employ chatbots and intelligent assistants to cope with routine customer queries and concerns.

In transport, AI is helping facilitate fully autonomous vehicles and autonomous driving systems (ADS), which steadily improve their driving and navigation skills through self-learning programs, as well as for real-time traffic management through urban spaces.

In agriculture, AI can be used for farm management and predictive analytics based on data from crop, soil, and weather monitoring to support decision-making and to optimize the use of resources (water, fertilizers, etc.). It can help detect pests and diseases by analysing images of plants and data on the behaviour of livestock. Agricultural robots and automation are saving labour in many resource-consuming tasks.



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ITU'S WORK ON AI

ITU is engaged in a wide range of work relating to new and emerging trends in AI, as well as helping ITU Members, Member States and stakeholders prepare for its wide-ranging policy and regulatory consequences.

The AI for Good platform [https://aiforgood.itu.int/programme/] focuses on uses of AI to help fulfil the essential needs of humanity, including achieving the 17 SDGs set out by the UN to be achieved by 2030, as an all-year, always online programme. The goal of the Summit is to identify practical applications of AI to advance the sustainable development goals and scale solutions for global impact. The Summit is organized by ITU in partnership with 38 UN sister agencies and co-convened with Switzerland.

The AI for Good YouTube channel hosts hundreds of videos highlighting interviews with AI leaders and innovators, innovations and demos showcasing AI solutions to accelerate the SDGs as a one-stop shop to catch up on emerging trends in AI for Good. Subscribe to the channel and join online for new updates and exclusive content as they go live on to explore ideas, insights and active discussions around AI to achieve the SDGs. The channel features keynotes, webinars, perspectives, an Innovation Factory and social media.

POLICY AND REGULATION

Through annual regulatory surveys and monitoring (https://www.itu.int/itu-d/sites/regulatory-market/), ITU tracks the growth of national AI strategies and policies. Machine Learning models are trained and fed by vast quantities of data, so it is vital to consider national policies in data privacy, regulation and data protection as well as approaches to the Internet of Things (IoT), sensor networks and the 5G networks making data transmission possible, when considering national approaches to AI.

According to ITU's latest Telecommunication/ICT Regulatory survey, some 18 countries had prepared specific strategies on AI by 2019, although more countries have AI sector-specific strategies, which has risen to 49 countries in 2021. However, AI encompasses diverse set of technologies, and few national strategies consider the field in total. Countries also have to consider the treatment of data flows now generated by IoT and sensor networks which feed ML models and AI technologies. Several countries, including the United States and Saudi Arabia, have prepared strategies on all three topics (5G, IoT and AI). According to the United Nations Conference on Trade and Development (UNCTAD; 2020), some two-thirds of all countries have developed policies for data protection, including AI for development.

AI IN RADIOCOMMUNICATION STANDARDS

ITU Radiocommunication (ITU-R) study groups and forthcoming reports examine the use of AI in radiocommunications:

• ITU-R Study Group 1 covers all aspects of spectrum management, including spectrum monitoring. Question 241/1 looks at "Methodologies for assessing or predicting spectrum availability".

• ITU-R Study Group 6, dedicated to broadcasting services, is studying AI and ML applications:

• Question ITU-R 144/6, "Use of AI for broadcasting", considers the impact of AI technologies and how can they be deployed to increase efficiency in programme production, quality evaluation, programme assembly and broadcast emission.

• Recommendation ITU-R BS.1387: "Method for objective measurements of perceived audio quality" about AI in the field of broadcasting.

• Report ITU-R BT.2447, "AI systems for programme production and exchange", discusses current applications and near-term initiatives, revised regularly to reflect the latest progress on AI for the applications in broadcasting.

ITU-T STANDARDS ADDRESSING AI AND MACHINE LEARNING

ICT companies in the networking business are introducing AI and ML to optimize network operations and increase energy and cost efficiency. New ITU standards provide: an architectural framework to integrate ML into 5G and future networks (ITU-T Y.3172); an evaluation framework for intelligence levels across different parts of the network (ITU-T Y.3173); and a framework for data handling in support of ML (ITU-T Y.3174. These standards originated in discussions by the ITU-T Focus Group on 'Machine Learning for Future Networks including 5G'.

The ITU-T AI/ML in 5G Challenge, introduced in 2020, rallied like-minded students and professionals from around the globe to study the practical application of AI and ML in emerging and future digital communication networks. The first edition attracted over 1,300 students and professionals from 62 countries, competing for global recognition and a prize fund of USD 36,000. By mapping emerging AI and ML solutions, the Challenge fosters a community to support the evolution of ITU standards. See the Challenge GitHub.

The ITU-T Focus Group on 'Environmental Efficiency for AI and other Emerging Technologies' aims to benchmark best practices and describe pathways towards a standardized environmental framework.

The ITU-T Focus Group on 'AI for Health', convened jointly with the World Health Organization (WHO), is working towards a framework and processes for performance benchmarking of AI for health solutions, including in response to COVID-19. It represents an open platform open to all stakeholders from different fields. The Focus Group works at the interface of multiple fields (e.g., ML/AI, medicine, regulation, public health, statistics) and includes decision-makers who value a standardized benchmarking framework. The ITU-T Focus Group on 'AI for Autonomous and Assisted Driving' is working to establish international standards to monitor and assess the behaviour of the AI 'drivers' in control of automated vehicles. The Global Initiative on 'AI and Data Commons', established in January 2020, assembles key resources for AI projects aligned with SDGs, supports rapid implementation and aims to help bring AI for Good projects to global scale.

AI and ML are widely used to construct models for the qualities of speech and other audio-visual (AV) data. An ITU-T working group on 'AI-enabled multimedia applications' (ITU-T Q5/16) is discussing standard requires for the quality assessments in AV streaming, in progressive-download and adaptive-bitrate AV (ITU-T P.1203) and video streaming (ITU-T P.1204).

New ITU-T standards address intelligent network analytics and diagnostics (ITU-T E.475) and the creation and performance testing for ML models to assess the impact of the transmission network on speech quality for 4G voice services (ITU-T P.565). Others address environmental sustainability, cable networks, and operational aspects of service provision and telecom management.

Other new ITU standards describe a datacentre infrastructure management (DCIM) system based on Big Data and AI technology (ITU-T L.1305), aiming to reduce the energy needs of datacentres, and provide the framework for a premium cable network platform to support industry in offering advanced multimedia services (ITU-T J.1600) for AI-assisted cable networks.

UN SYSTEM ACTIVITIES

In 2019 the UN Chief Executive Board endorsed the ITU-coordinated UN system-wide strategic approach and road map for supporting capacity development on AI, under the aegis of the High-Level Committee on Programmes (HLCP). HLCP has also worked on the ethics of AI, and taking into consideration the Secretary-General's Roadmap for Digital Cooperation, the 40th HLCP session decided in October 2020 to establish an HLCP interagency working group on AI (IAWG-AI), co-led by UNESCO and ITU to focus on policy and programmatic coherence of AI activities within the UN. The group leverages the stocktaking and gap analysis exercise by ITU regarding internal capacities within the UN and other stakeholders in relation to the UN system-wide strategy.

ITU has also issued the "Compendium of UN Activities on AI" as an overview of activities being carried out by the UN system. A joint effort between ITU and 37 UN agencies and bodies, all partners of the 2020 AI for Good Global Summit, resulted in an updated version of the compendium at the sixth AI for Good UN Partners Meeting, held virtually on 21 September. The 2020 Compendium covers around 260 cases and projects run by 36 UN agencies and bodies, in areas ranging from smart agriculture and food systems to transportation, financial services, healthcare and AI solutions to combat COVID-19.

CLIMATE CHANGE

OVERVIEW

Climate change has been recognized by the United Nations as "one of the greatest challenges of our time".

Given the growing proliferation of devices in our increasingly connected lives, information and communication technologies (ICTs) are part of the problem, and responsible for a growing amount of carbon emissions and e-waste.

ICTs can also contribute to reducing carbon emissions as part of the solution – for example, through 'dematerialization' (e.g. replacing books with digital books) or through substitution (e.g. replacing travel for meetings with participation in teleconferences).

The 'value' of an ICT service should not necessarily be measured in terms of its popularity, consumer convenience or carbon footprint. Many ICT services have vital benefits. For example, various ICT services are used for monitoring storms and measuring climate change.

ITU works on addressing climate change due to ICTs and through ICTs. Work includes a broad portfolio of activities in e-waste; identifying the standardization needs to develop a sustainable approach to artificial intelligence and other emerging technologies; and supporting the growth of satellite surveillance and monitoring services from space for, for example, more accurate weather forecasting and prediction of extreme weather events linked to climate change, and particularly for predicting the strength, path and location of landfall of tropical storms.

ITU's work on addressing climate change contributes towards SDG 13: climate action, as well as the goals for life below water (SDG 14) and life on land (SDG 15).

CHALLENGES

The United Nations Framework Convention on Climate Change (UNFCCC) defines climate change as "a change of climate that is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and that is in addition to natural climate variability observed over comparable time periods". The Intergovernmental Panel on Climate Change (IPCC) defines climate change as a "change in the state of the climate that can be identified (e.g. using statistical tests) by changes in the mean and/or the variability of its properties, and that persists for an extended period, typically decades or longer. It refers to any change in climate over time, whether due to natural variability or human activity". The 2030 Agenda acknowledges climate change as "one of the greatest challenges of our time" [8]. It elaborates that climate change and "its adverse impacts undermine the ability of all countries to achieve sustainable development. The survival of many societies, and of the biological support systems of the planet, is at risk" [9].

According to NASA, the immediate signs of climate change include: global temperature rise; warming oceans; ice sheet and glacial retreat; decreasing snow cover; sea level rise; declining Arctic sea ice; extreme weather events; and ocean acidification [10]. Many of these consequences of climate change are monitored using satellite imagery from outer space.

No matter where you live, everyone stands to be affected by the consequences of climate change. Some 2.4 million (40%) of the total world population live within 100km of the coast today, with at least 11-15% of the population of small island developing states (SIDS) living on land with an elevation of 5 meters or lower [11]. The World Bank identifies that cities are also increasingly at risk from the impacts of climate change, with more than 80% of the global costs of adaptation to climate change expected to be incurred by and within cities.

OPPORTUNITIES

ICT products and services consume energy, that generates carbon emissions over their life cycle in:

a) Manufacturing and production: It has been estimated that a tonne of laptops could be responsible for emissions of up to 10 tonnes of carbon dioxide [12].

b) Usage:

Growth in number of consumer devices: Cisco estimates that nearly 650 million mobile devices and connections were added in 2017 [13]. The Organisation for Economic Co-operation and Development (OECD) estimates that a typical OECD household with two children may now have up to ten connected devices on average per household [14].

Data flows: Cisco, for example, estimates that global mobile data traffic grew by 71% in 2017. Global mobile data traffic reached 11.5 Exabytes per month at the end of 2017, up from 6.7 Exabytes per month at the end of 2016 [15].

Energy use & efficiency across networks: Standards can help address these concerns by providing common measurement methodologies. ITU has developed KPIs for measuring carbon footprint, energy performance and efficiency across telecom/ICT networks – see below.

Data centres: The number of data centres is increasing rapidly worldwide, with a large number of data centres being installed in Scandinavia (e.g. Iceland), where average temperatures are lower. Data centres vary in their energy efficiency and energy sources, with some powered by renewable energy [16].

c) Disposal: In early 2019, the United Nations found that US$62.5 billion dollars in materials are lost in approximately 50 million tonnes of annual e-waste, which could be tripled by 2050[17].

The installation of 'smart infrastructure' allows to improve monitoring and evaluation of energy consumption across networks in real-time. For example, smart electricity meters can help building-owners and occupiers understand their energy consumption better. Advanced computer modelling can help telecom operators plan for and handle data traffic more efficiently. Smart traffic lights can help reduce traffic jams and greenhouse gas emissions and pollution from cars.

In fact, the carbon footprint of ICT goods and services depends in large part on how/where energy is generated and whether power is generated from fossil fuels or renewable energy sources. Renewable energy sources are not de facto clean energy sources in terms of carbon footprint – although they are cleaner. Carbon-fueled power stations emit 820g equivalent of CO2 equivalent per kWh of energy, gas-fired power stations 490g equivalent of CO2 equivalent per kWh of energy, photovoltaic sources 41, hydraulic energy 24, nuclear power stations 12 and wind-powered stations 11 gCO2eq per kWh [18].

ITU'S CONTRIBUTION

Various ICT services are useful for monitoring climate change and storms (e.g. better modelling and prediction of weather and of climate, space-based observation of greenhouse gas emissions or GHGs). ITU supports the growth of satellite surveillance and monitoring services from space for:

Monitoring GHG emissions and pollution;

Improving climate modelling and prediction of trends;

Forecasting weather more accurately and predicting extreme weather events linked to climate change.

ITU-R Working Party 7B (WP 7B) studies space radiocommunication applications relevant to climate change. ITU-R Working Party 7C (WP 7C) studies the remote sensing systems that are important for monitoring and tracking the extent, pace and acceleration of climate change.

ITU-T Study Group 5 studies 'Environment, climate change and circular economy'. The group has been working on developing international standards (i.e. ITU-T Recommendations) that support the sustainable use of ICTs (including products, services, installation, infrastructure, etc.). Recently, Study Group 5 is working to align the development of ICTs with the UN 2030 Agenda for Sustainable Development and the UNFCCC Paris Agreement.

Recognizing the growing footprint of digital technologies, ITU has also created the new Focus Group on "Environmental Efficiency for AI and other Emerging Technologies". This focus group will study the environmental performance of AI, Big Data application, blockchain and other digital technologies. The group will identify the standardization needs to develop a sustainable approach to AI and other emerging technologies. ITU published a report, entitled "Turning digital technology innovation into climate action", to highlight the emerging role of digital technologies in accelerating climate actions and tackling the e-waste challenge. With other UN partners, ITU also recently published the report, "Frontier Technologies to Protect the Environment and Combat Climate Change" (2020).

The United for Smart Sustainable Cities (U4SSC) initiative is a UN initiative coordinated by ITU and UNECE with the support of 14 other UN agencies and programmes. The initiative is dedicated to support the transition to smart sustainable cities and is developing technical reports and deliverables that encourage circularity actions in cities and examine the impacts of frontier technologies in cities.

In addition, ITU organizes multi-stakeholder events to highlight the role of ICTs in climate change. With eight other UN agencies and programmes, ITU hosts a Symposium on ICT, Environment & Climate Change [19] regularly, which brings together leading telecom executives, policy-makers, service providers, civil society, the academia and UN representatives to discuss how frontier technologies can help combat climate change. ITU also organizes the Green Standards Week every year to debate key issues relating to ICT standards and the environment. This event brings together the ICT sector, policy-makers, city planners, representatives from civil society, the academia and technical experts to share experiences in building smart sustainable cities and how standards can improve the sustainability of different sectors.

REFERENCES

[1] http://www.un.org/en/development/desa/population/ publications/pdf/ageing/WPA2017_Highlights.pdf.

[2] http://www.who.int/pbd/deafness/activities/MLS/en.

[3] https://www.who.int/blindness/publications/ globaldata/en.

[4] https://www.who.int/deafness/estimates/en.

[5] https://www.un.org/development/desa/disabilities/convention-on-the-rights-of-persons-with-disabilities/article-9-accessibility.html.

[6] https://broadbandcommission.org/Documents/publications/The%20ICT%20Opportunity%20for%20a%20Disability_Inclusive%20Development%20Framework.pdf.

[7] ITU-R Resolution 67-1 governs "Telecommunication/ICT accessibility for persons with disabilities and persons with specific needs". https://www.itu.int/pub/R-RES-R.67-1-2019.

[8] Para 14, "Transforming Our World: The 2030 Agenda for Sustainable Development", available at: https://sustainabledevelopment.un.org/content/documents/21252030%20Agenda%20for%20Sustainable%20Development%20web.pdf.

[9] Para 14, "Transforming Our World: The 2030 Agenda for Sustainable Development", available at: https://sustainabledevelopment.un.org/content/documents/21252030%20Agenda%20for%20Sustainable%20Development%20web.pdf.

[10] https://climate.nasa.gov/evidence.

[11] https://www.un.org/sustainabledevelopment/wp-content/uploads/2017/05/Ocean-fact-sheet-package.pdf.

[12] https://news.itu.int/lets-rethink-e-waste-waste-free-economy.

[13] https://www.cisco.com/c/en/us/solutions/collateral/service-provider/visual-networking-index-vni/white-paper-c11-738429.html.

[7-14] OECD: https://www.oecd.org/sti/ieconomy/technology-foresight-forum-2014.htm.

[15] https://www.cisco.com/c/en/us/solutions/collateral/service-provider/visual-networking-index-vni/white-paper-c11-738429.html.

[16] https://sustainability.fb.com/innovation-for-our-world/sustainable-data-centers.

[17] "A New Circular Vision for Electronics – Time for a Global Reboot", 24 January 2019, available at: https://www.itu.int/en/mediacentre/Pages/2019-PR01.aspx.

[18] The French Intergovernmental Expert Group on Climate Change (GIEC) and figures quoted by the French Society of Nuclear Energy (SFEN) (which consists of industry professionals), "Climat: faut-il sortir du nucleaire pour sauver la planete ? Sept arguments pour comprendre le debat", 9 July 2019, at: https://www.francetvinfo.fr/societe/nucleaire/climat-faut-il-sortir-du-nucleaire-pour-sauver-la-planete-sept-arguments-pour-comprendre-le-debat_3504835.html.

[19] https://www.itu.int/en/ITU-T/climatechange/symposia/201905/Pages/default.aspx.