

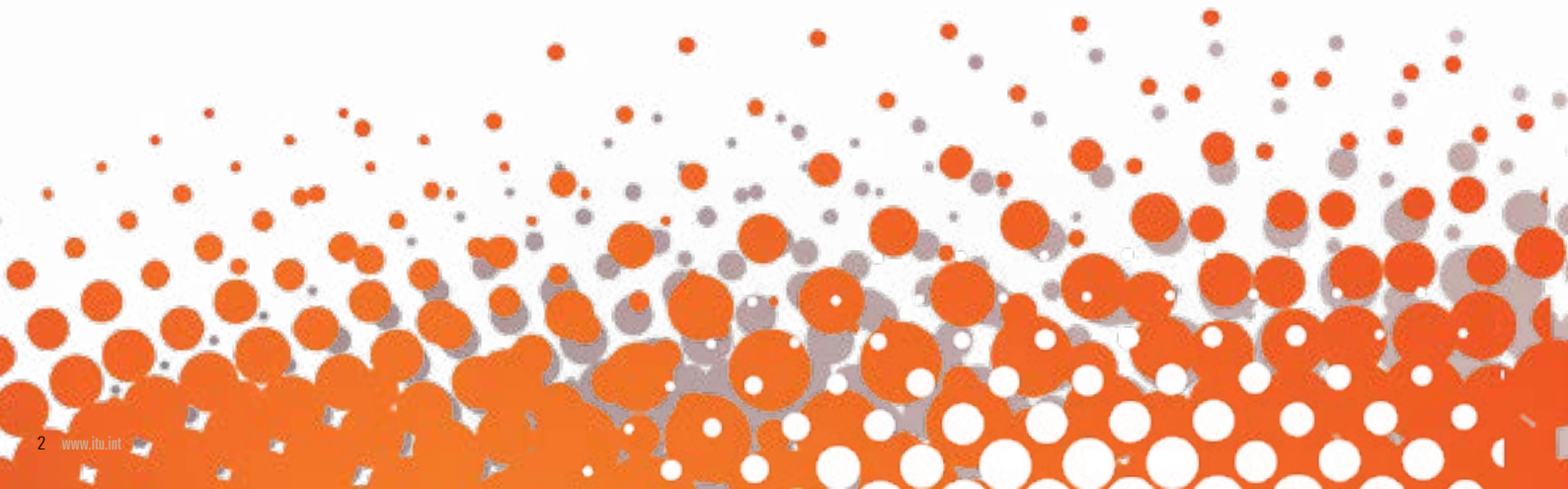


ITU-T

standardization

Committed to connecting the world





# ITU's Telecommunication Standardization Sector (ITU-T) develops international technical standards that ensure networks and technologies seamlessly interconnect.

ITU-T standards (ITU-T Recommendations) provide the technical backbone to global communications, increasing the reach of international information and communication technology (ICT) networks and fostering the market growth necessary to the production of affordable ICTs.

Without ITU-T standards:

- You couldn't make a telephone call from one side of the world to the other
- You wouldn't be able to surf the Internet
- Modern communications, as we know them, just wouldn't exist



# Connecting the World

As the Secretary-General of ITU I have overseen the organization during an extraordinary period of technological development. I am proud to say that the standardization work of the Union has kept pace and many of the ITU Recommendations issued in this time have become defining elements of today's global communications infrastructure.

Markets look to standards as building blocks of a competitive business environment. Capturing innovation and proven best practices, standards grant companies access to greater numbers of buyers, sellers and partners; expanding the scope of opportunity enjoyed by all of a market's constituents.

The technical standardization undertaken by ITU plays a formative role in the ICT market. Standards are critical to the interoperability of ICTs and, whether we exchange voice, video or data messages, standards enable global communications by ensuring that countries' ICT networks and devices are 'speaking the same language'.

International standards increase the reach of international ICT networks, facilitating the market growth necessary to the production of affordable ICTs. Stimulating increased competition and improvements to the compatibility and interoperability of ICT networks and devices, standards play a significant role in expanding the choice of ICT products and services available to consumers.

International ICT standards avoid costly market battles over preferred technologies, limiting market players' ability to establish 'walled gardens' of proprietary solutions that lock-in customers by virtue of their not interoperating with solutions provided by other players.

Standards are also an essential aid to developing countries in building their infrastructure and encouraging economic development and, to market players in emerging economies, international standards offer an avenue through which to access new markets.

Thousands of dedicated experts – from governments, the private sector, academia and civil society – come together at ITU-T meetings to develop these standards for the benefit of all of the world's people. These are exceptional individuals that are volunteering their time and expertise in service of the public interest.

It is incumbent upon me as Secretary-General to ensure that these people, our valued members, are provided with the best facilities, procedures and environment to underpin ITU's mission to Connect the World. You have my assurance that I will continue to do so.

**Dr Hamadoun I. Touré**

*Secretary-General*

*International Telecommunication Union*



# Welcome to ITU-T

Over 4000 ITU-T standards are in force today, including specifications that define the telecommunications numbering system; compression codecs that encode voice, video and data messages; the optical networks and protocols that connect ICT networks across the world; and the copper-based, optical and wireless access technologies through which end-users connect and contribute to the Information Society.

ICTs today underpin almost all industry processes and nearly every aspect of our daily lives. The seismic shifts ICTs have initiated in business practice and consumer behaviour have sparked a similarly pronounced evolution of the ICT standardization ecosystem.

'Vertical sectors' not traditionally part of the ICT community are today in demand of ICT standards tailored to their unique needs, and, in response to this convergence of industries and technologies, ITU-T is forging new relationships to bring about the widespread deployment of innovations such as e-health, e-learning, intelligent transport systems, mobile money, and smart grid.

ITU-T's strength lies in its unique public-private partnership of members and contribution-led, consensus-driven approach to standards development. All countries and all companies, no matter how large or small, are afforded equal rights to influence the development of ITU-T Recommendations.

ITU-T members continue to build consensus-derived answers to questions of common global concern. ITU-T is making great strides in bridging the standardization gap between developed and developing countries; tackling climate change; improving energy efficiency and the management of e-waste; and increasing the accessibility of ICTs to persons with disabilities.

From its beginnings in 1865 as a body standardizing international telegraph exchange, through its formative role in telecommunications, and in today's converged ICT ecosystem, ITU-T has provided the world's best facilities to the global standardization community and remains the world's only truly global ICT standards body.

Membership allows for unparalleled networking opportunities with the industry's top talent in representatives of over 700 private sector and academic entities, in addition to 193 governments and their regulators.

ITU-T's secretariat will be happy to answer any of your questions on how we can meet your needs. We look forward to hearing from you.

**Malcolm Johnson**

*Director*

*Telecommunication Standardization Bureau*



# Membership

ITU-T membership is an opportunity for the private sector and academia to work together with international administrations in shaping the future of ICT in an open, fair and transparent environment. Alongside opportunities to 'network' and influence the creation of global standards, members receive unique returns on investment by being able to implement technologies ahead of the pack, not to mention getting products and services to market faster than their competitors can. Exposure on an international platform also offers unparalleled marketing opportunities.

ITU-T's global image comes with the mark of quality and efficiency that ITU, as a specialized agency of the United Nations, lends to the sector. The standardization work is carried out in ITU-T Study Groups. Member States, Sector Members and Academia members are, regardless of size, entitled to unlimited participation in any or all of ITU-T's Study Groups. Associate membership allows companies with a specific interest to follow the work of a particular Study Group at a reduced cost.

*For more information, also refer to [itu.int/go/ITU-T/membership](http://itu.int/go/ITU-T/membership)*



# Other Ways to Participate

ITU-T strives to meet the needs of all stakeholders in the development of its standards and has developed means to allow non-members to contribute to ITU-T work.

ITU-T workshops are a popular way of progressing existing work areas and exploring new ones. Workshops are normally free-of-charge events, augmenting the work of the study groups by proposing new standardization work areas and seeking the views of non-members and other standards developers. Events may be held anywhere in the world and are increasingly seen as a means of outreach to developing countries.

Workshops have focused on a broad variety of topics including cybersecurity, climate change and e-waste, accessibility, telemedicine, intelligent transport systems (ITS), future networks, smart

grid, cloud computing, and disaster relief and network resilience, just to name a few.

ITU-T Focus Groups provide a more hands-on way to contribute to ITU-T standardization work. Allowing the participation of any outside organization or stakeholder, these groups decide their own working methods to, as rapidly as possible, lay the foundations for new work in ITU-T Study Groups and the eventual publication of related ITU-T Recommendations.

Recent Focus Groups have addressed topics including smart grid, machine-to-machine communications (M2M), ICT innovations, resilience to disasters, smart cable TV, accessibility, smart water management, and smart sustainable cities.

For more information, also refer to [itu.int/go/ITU-T/focusgroups](http://itu.int/go/ITU-T/focusgroups)



# Academia

Academic and research institutions are invited to participate in ITU's work through an Academia membership category established in 2010.

ITU-T is looking to increase the participation of universities and other academic institutions in its standardization process. There are myriad examples of this policy bearing fruit, with many standards having been heavily influenced by academia.

The Kaleidoscope series of academic conferences was launched in 2008 and, viewing a broad spectrum of ICT research through a 'Kaleidoscope', participants in these forward-looking events help ITU-T identify new topics for standardization. Each year Kaleidoscope issues a

call for academic papers to enter a peer-review process deciding the selection of papers to be presented at the conference and published in the *IEEE Xplore* Digital Library. Winning papers receive a share of a prize fund and are considered for publication in *IEEE Communications Magazine*.

The TSB Director's Ad hoc Group on Education about Standardization is promoting formal education to students at undergraduate and graduate levels on all aspects related to international standards, such as standards development activities, standard strategy planning, and business case studies demonstrating the importance of standards to industry.

For more information, also refer to [itu.int/go/ITU-T/academia](http://itu.int/go/ITU-T/academia)





# Bridging the Standardization Gap

Standards are an essential tool in bridging the digital divide. Developing countries look to international standards for best-practice guidance in building communications infrastructure critical to economic development.

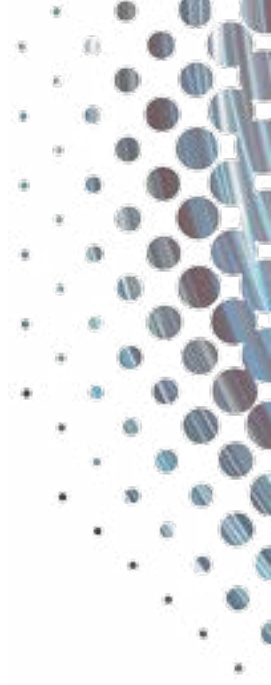
The 'standardization gap' can be defined as disparities in the ability of developing countries – relative to those in the developed world – to access, implement, contribute to and influence international ICT standards such as ITU-T Recommendations.

Participation in the standardization process is a means through which developing countries

accelerate the deployment of new networks and services.

ITU's activities to bridge the standardization gap include the establishment of regional groups within ITU's various expert groups; meetings and standardization forums in developing regions; guidelines to assist developing countries in establishing national standardization secretariats; e-learning courses on the implementation of ITU-T Recommendations; online 'remote participation' tools; and fellowships that aid the participation of certain developing countries in ITU-T work.

*For more information, also refer to [itu.int/go/ITU-T/bsg](http://itu.int/go/ITU-T/bsg)*



# Accessibility

In line with the United Nations Convention on the Rights of Persons with Disabilities, ITU works to increase the accessibility of ICTs to persons with disabilities by raising awareness of their right to access telecommunications/ICTs, mainstreaming the inclusion of accessibility features in ICT standards, and providing education and training on key accessibility issues.

ITU-T develops standards and guidelines for audiovisual media accessibility and ICTs' consideration of human factors, and also holds regular workshops and events in different regions

on this topic. ITU-T convenes groups where experts – especially those with disabilities – provide guidance to system designers, service providers and operators in the interests of creating all-inclusive communications.

ITU-T's work to improve ICT accessibility and digital inclusion involves a wide variety of organizations and facilitates the active participation of experts with disabilities in its activities, representing a multi-stakeholder collaboration of government, industry, civil society, and research and academia.

*For more information, also refer to [itu.int/go/ITU-T/accessibility](https://www.itu.int/go/ITU-T/accessibility)*



# Transport and Access

ITU-T's transport and access standards have shaped the global telecommunication infrastructure and liberated the development of the Internet. These standards define optical transport networks that enable long-haul global information exchange, fibre- or copper-based access networks through which subscribers connect, and home networks that connect in-premises devices and interface with the outside world.

The ITU-T defined Optical Transport Network (OTN) is rapidly supplanting previous generations of equipment through its support for both optical (wavelength division or WDM) and digital multiplexing techniques, which greatly improve network efficiency while also supporting legacy systems.

Digital subscriber line (DSL) standards provide broadband Internet connections to over 600 million households around the world, and ITU-T continues to challenge the existence of a ceiling to network capacity in the predominantly copper 'last mile' (between the exchange and the customer premises). VDSL2 vectoring achieves access speeds of up to 250 Mbit/s, and the next update of DSL (G.fast) will raise the bar to 1 Gbit/s by combining the best aspects of optical networks and DSL.

ITU-T also standardizes shared-access fibre-to-the-home (FTTH) technologies known as passive optical networks (PONs), which are a crucial step towards all-optical networks. 10-Gigabit-capable PON (XG-PON) is ITU-T's latest series of PON standards and achieves access speeds of up to 10 Gbit/s.

For more information, also refer to [itu.int/tsg15](http://itu.int/tsg15)



# Smart Grid and Home Networking

Electricity grids are being modernized to reflect the energy demands of the 21st century. A smart grid adds communications and thus monitoring, analysis and control capabilities to the electricity grid; increasing its efficiency and reliability, reducing its energy consumption, and minimizing its greenhouse gas (GHG) emissions.

ITU-T's experience in optimizing the communications capabilities of wired infrastructure makes it a natural home to standardization work on smart grid. ITU-T has

produced a family of orthogonal frequency-division multiplexing (OFDM)-based narrowband powerline communications (NB-PLC) standards that reuse the electric grid as a telecommunication medium, primarily to monitor, analyse and control power supply/usage.

This work builds on G.hn (ITU-T G.996x-series) which provides broadband home-networking over telephone wiring, coaxial cable and powerline wiring.

*For more information, also refer to [itu.int/tsg15](http://itu.int/tsg15)*

# Multimedia

ITU standards have dominated the digital video compression arena since the publication of ITU-T's first video codec in 1984.

ITU's Primetime Emmy award winning video coding standard, H.264/AVC, continues to deliver excellent quality across the entire bandwidth spectrum, from high-definition TV to videoconferencing and '3G' mobile multimedia. H.264/AVC is omnipresent in the audiovisual sphere, for example, in Blu-ray and gaming technology, high-definition TV broadcasting and mobile applications.

H.264/AVC is now being supplanted by H.265/HEVC (High efficiency video coding). With double the compression power, HEVC is expected to provide the common platform for the next decade of innovation in the video sphere and will be phased in as new products and services outgrow the limits of current network and display technology.

*For more information, also refer to [itu.int/tsg16](http://itu.int/tsg16)*

Standards for third-generation conferencing systems are being developed to provide innovative ways for people and systems to interact with anyone, anywhere, anytime.

IPTV and digital signage are hot topics with experts defining advanced standards that will enable the global rollout of new interactive services in domains such as the Internet of Things (IoT), telepresence, e-health, and vehicular gateways for ITS.





# Smart Cable TV

ICT is enabling new improvements to broadcasting technology and the provision of innovative audiovisual experiences over cable networks. Smart Cable TV will underscore ultra-high definition and 3D television, cable-based video communication and telepresence, and interactive home-environment control and monitoring.

ITU-T work on Smart Cable TV covers advanced transport technologies including cable-related aspects of M2M and IoT, secure content and application delivery, user interfaces and accessibility, and multi-screen and mobile device applications.

*For more information, also refer to [itu.int/tsg09](http://itu.int/tsg09)*



# e-Health

The evolution of advanced digital telecommunication techniques has enabled the development of multimedia systems to support e-health applications, in particular in the area of telemedicine.

e-Health refers to the use of ICTs to support health needs, while telemedicine is considered the part of e-health where telecommunication systems allow the interconnection of remote locations to enable access to distant medical resources and expertise.

The adoption and success of e-health and telemedicine applications will demand conformance with standards to increase interoperability among systems and to reduce the cost of devices through economies of scale.

ITU-T is developing standardized multimedia systems to support widespread deployment of

e-health applications, working in collaboration with ITU's Telecommunication Development Sector (ITU-D) and with organizations including WHO, ISO, HL7, Continua Health Alliance, DICOM, GSMA, and DAISY consortium.

An important milestone for global e-health standardization was achieved in 2013 with the approval of Recommendation ITU-T H.810, an ITU-T formalization of Continua Health Alliance's Design Guidelines for the interoperability of personal health systems.

In addition to technical questions, discussions around e-health encompass a variety of aspects (e.g. legal, ethical, cultural, economic, regional) and the international, consensus-driven processes of ITU-T thus provide the right environment to harmonize and coordinate the development of a set of open global standards for e-health applications.

For more information, also refer to [itu.int/tsg16](http://itu.int/tsg16)



# Numbering and Interconnection

ITU-T numbering standards have played a key role in shaping today's telecom networks. They provide the structure and functionality of telephone numbers, and without them we would not be able to communicate internationally.

ITU-T assigns international numbering resources (INRs), maintains authoritative INR databases, and publishes a fortnightly ITU Operational Bulletin that enables the accurate international connectivity of telecom networks.

ITU-T is tasked with the complicated job of recommending principles for the harmonization of international interconnection rates. ITU-T's aim is to keep rates for services as fair and as low as

possible, without compromising service quality. Interconnection rates are a key concern for our members and, in particular, for the developing world.

ITU-T Recommendations also enable the identification of a roaming mobile terminal in a foreign network and the subsequent querying of the home network for subscription and billing information. ITU-T is fostering collaboration among its members on international roaming charges and the costs of international Internet connectivity, an aim elevated in importance as the industry shifts to IP-based next-generation and future networks.

For more information, also refer to [itu.int/tsg02](http://itu.int/tsg02) and [itu.int/tsg03](http://itu.int/tsg03)





# Quality of Service

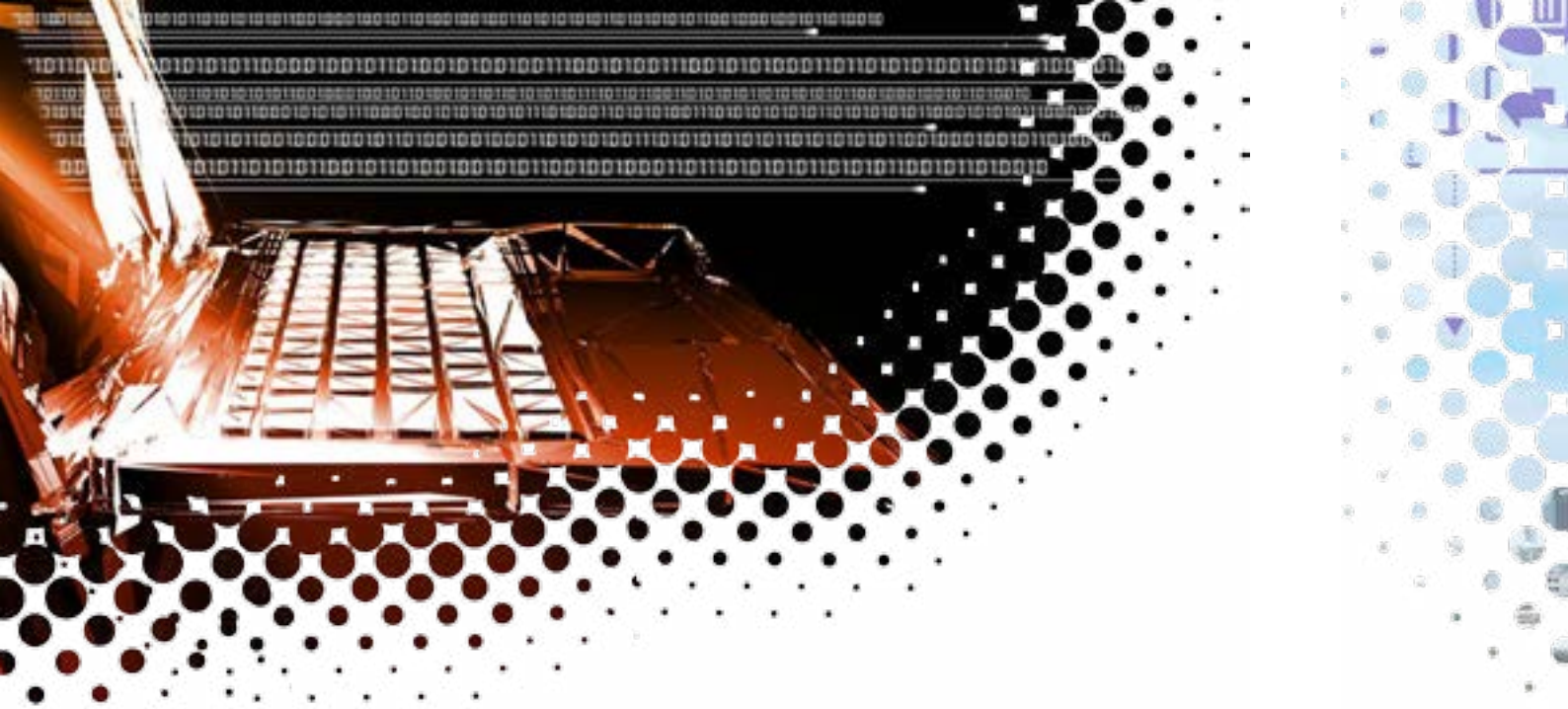
## Quality of Experience

ITU-T develops standards on performance, QoS and QoE applicable across the full spectrum of ICT terminals, networks and services.

Ensuring adequate QoS/QoE in today's IP-based communications ecosystem is a complex challenge, in large part stemming from the

emergence of new multimedia services and applications. ITU standards thus work to achieve the end-to-end performance levels required to support satisfactory QoS/QoE in an IP environment characterized by a wide array of user applications.

*For more information, also refer to [itu.int/tsg12](http://itu.int/tsg12)*



# Cybersecurity

At the World Summit on the Information Society (WSIS), ITU was charged with building confidence and security in the use of ICTs.

Standards give businesses a systematic approach to information security. Given its international scope, and the fact that ITU brings together the private sector and governments to coordinate work on standards, ITU is in a unique position to influence the harmonization of security worldwide.

For more information, also refer to [itu.int/tsg17](http://itu.int/tsg17)

ITU public-key infrastructure (PKI) standards were instrumental in the rise of e-business. Today the ITU CYBEX series (Cybersecurity Information Exchange) presents standardized means to exchange the cybersecurity information demanded by computer incident response teams (CIRTs).

ITU-T works in close collaboration with many other organizations dealing with cybersecurity and maintains a roadmap of all related standards activity.

# Emergency Communications

Functional communications are essential when disaster strikes. The ITU-T-standardized early warning system is backed-up by call prioritization specifications, ensuring that emergency response is timely and efficient.

For more information, also refer to [itu.int/go/ITU-T/emergency](http://itu.int/go/ITU-T/emergency)

Digital signage technology being standardized in ITU introduces new opportunities to deliver critical pre- and post-disaster information to affected populations. ITU-T Recommendations also address network restoration and management during emergencies.



# Cloud Computing

ITU-T cloud computing standards detail the framework requirements and reference and functional architectures of the cloud computing ecosystem, covering inter- and intra-cloud computing and technologies supporting XaaS (X as a Service).

ITU-T cloud standardization work includes infrastructure and networking aspects of cloud computing models, as well as deployment considerations and requirements for

interoperability, data portability and security. Cloud-based 'big data' is another important element of this work.

Given that cloud computing relies on the interplay of a variety of telecom and IT infrastructure resources, ITU-T develops standards enabling consistent end-to-end, multi-cloud management and the monitoring of services exposed by and across different service providers' domains and technologies.

For more information, also refer to [itu.int/tsg13](http://itu.int/tsg13)



# IPv6

In light of the massive worldwide deployment of Internet-related resources and Internet-connected consumer devices, the issue of the depletion of Internet Protocol version 4 (IPv4) addresses is increasingly pertinent to the sustainable development of the future Internet.

ITU is committed to promoting the deployment of the next-generation Internet Protocol – version 6 (IPv6). In addition to other features, IPv6 (with its 128 bit address space) is aimed at addressing the current shortage of public IPv4 addresses.

ITU-T Study Groups are developing specifications on interworking and security aspects of IPv6 deployment in next-generation networks (NGN). The practical application of IPv6 is another field of ITU-T study, with initiatives such as the ITU IPTV IPv6 Global Testbed offering ITU members a platform to develop interoperable IPTV-based applications – targeting areas including e-health and accessibility – running over quality-managed IPv6 networks.

*For more information, also refer to [itu.int/go/ITU-T/ipv6](http://itu.int/go/ITU-T/ipv6) and [itu.int/go/ITU-T/i3gt](http://itu.int/go/ITU-T/i3gt)*



# Software-defined networking

ITU-T standardization work to enable software-defined networking (SDN) has been championed by private-sector ITU members in search of greater network efficiency. ITU-T is standardizing the framework of SDN, formal specification and verification methods, and practical SDN solutions for enhancements to NGN.

ICT market players see SDN and network virtualization as critical to countering the increases in network complexity, management and operational costs traditionally associated with the introduction of new services or technologies.

SDN proposes to decouple the control and data planes by way of a centralized, programmable control-plane and data-plane abstraction. This abstraction will usher in greater speed and flexibility in routing instructions and the security and energy management of network equipment such as routers and switches.

SDN is a promising route towards network virtualization, a major shift in networking technology to give network operators the ability to establish and manage new virtualized resources and networks without deploying new hardware technologies.

For more information, also refer to [itu.int/go/ITU-T/sdn](http://itu.int/go/ITU-T/sdn)



# Future Networks

Future networks (FNs) are networks beyond NGN expected to enjoy early realization around 2020 in prototyping or phased deployments. FNs will provide services, capabilities and facilities far exceeding those achievable with existing technologies.

ITU-T is standardizing FNs with the objectives of service, data, environmental and socio-economic awareness. ITU-T Recommendations under development will support identification frameworks, energy saving, network virtualization, soft network architecture for mobile, social device networking, SDN, and different facets of the smart ubiquitous network (SUN).

*For more information, also refer to [itu.int/tsg13](http://itu.int/tsg13)*



# Environment

The environment, climate change and e-waste have taken centre stage in the global development agenda, of which the ICT industry is a crucial part. ICTs are estimated to be responsible for roughly 2-3 per cent of total GHG emissions and efforts are underway to mitigate the sector's carbon footprint. ICTs are also 'enabling technologies' in the reduction of GHG emissions across other industry sectors through effects such as travel avoidance, telecommuting and dematerialization.

The ITU-standardized Universal Charging Solution for mobile phones enacts a 50 per cent reduction in standby energy consumption, as well as the elimination of an estimated 51,000 tonnes of redundant chargers and 13.6 million tonnes of GHG emissions each year.

ITU-T is developing a set of standardized methodologies to assess the environmental impacts of ICTs, both in terms of ICTs' GHG emissions and the emissions savings created through green ICT applications in other industry sectors. The methodologies are being developed in cooperation with over 60 organizations including major ICT private-sector organizations, the United Nations Framework Convention on Climate Change (UNFCCC) and the United Nations Environmental Programme (UNEP).

ITU is working to reduce its own carbon footprint by adopting more energy-efficient working methods, including paperless and virtual meetings, and online 'remote participation' tools.

For more information, also refer to [itu.int/go/ITU-T/climate](http://itu.int/go/ITU-T/climate)



# Internet of Things

By 2020, today's nascent IoT will have grown into an estimated 50 billion devices connected to the Internet; with automobiles, machinery and electricity meters connecting to ICT networks and exchanging information as a tool to increase efficiency.

ITU-T is developing standardized schemes of identifiers needed to enable the IoT and its many constituent technologies such as the Web of Things; ubiquitous sensor networks (USN); radio-frequency identification (RFID); mobile item identification and management (MIIM); automatic identification and data capture (AIDC); geospatial information; and M2M.

*For more information, also refer to [itu.int/go/ITU-T/iot](http://itu.int/go/ITU-T/iot)*

## M2M

M2M is considered a key enabler of applications and services across a broad range of vertical sectors such as healthcare, logistics, transport and utilities.

ITU-T is working towards a common M2M service layer agreed at the global level involving stakeholders from the ICT and vertical market communities. ITU-T work on M2M places emphasis on the healthcare market, developing application programming interfaces (APIs) and protocols supporting e-health applications and services.

*For more information, also refer to [itu.int/go/ITU-T/m2m](http://itu.int/go/ITU-T/m2m)*





# Intelligent Transport Systems

Today's communications capabilities give cars the potential to foresee and avoid collisions, navigate the quickest route to their destination, make use of up-to-the-minute traffic reports, identify the nearest available parking slot, minimize their carbon emissions, and provide multimedia communications.

As new forms of propulsion have emerged, ICTs have become essential in the management of battery status, warranty concerns and driver behaviour, and the development of the smart grid has introduced the possibility of using electric vehicles as energy-storage facilities during network downtime.

Safety is a recurrent theme in the study of ITS. Highest on the list of priorities in the development of ITS standards is the task of ensuring that vehicles' incorporation of connected technologies will not exacerbate driver distraction.

It is essential that the automotive and ICT industry sectors work together to understand the requirements of ITS so as to agree on the solutions to be provided by network platforms.

ITU-T works with governments, private-sector players, academia and other standards bodies in the Collaboration on ITS Communication Standards (CITS) – a forum with the aim of enacting an internationally-accepted, globally-harmonized set of ITS communication standards to enable the rapid deployment of interoperable ITS products and services.

In addition, the Future Networked Car symposium at the Geneva International Motor Show brings together experts from the motoring and ICT sectors to identify the standardization needs of the systems merging automobiles with ground-breaking computer and communication technologies.

For more information, also refer to [itu.int/go/ITU-T/cits](http://itu.int/go/ITU-T/cits)



# Electromagnetic Effects

ITU provides technical frameworks for the responsible management of the ICT systems that underpin wireless communications.

ITU-T Recommendations provide high-level frameworks for the measurement and management of human exposure to electromagnetic fields (EMFs) emitted by telecommunication equipment (best-practice regulatory guidelines), offering guidelines for the assessment of human exposure, and the verification of compliance with the human-exposure limits recommended by the World Health Organization (WHO) and other international SDOs.

ITU-T Recommendations provide requirements and guidance to protect telecommunication networks and equipment from damage and

interference stemming from disturbances, such as those produced by power faults, lightning strikes, and induced voltages or direct contact between power lines and telecommunication lines.

Electromagnetic compatibility (EMC) is another key component of this work, ensuring that the functionality of telecommunication equipment is not compromised by electromagnetic interference related to EMFs and conducted disturbances emitted by other electrical or communications systems. EMC is becoming particularly relevant in accounting for the convergence of telecommunication and IT equipment, as well as in ensuring the efficient operation of home networks.

*For more information, also refer to [itu.int/go/ITU-T/emf](https://www.itu.int/go/ITU-T/emf).*



# Smart Sustainable Cities

An estimated 70 per cent of the world's population will live in cities by 2050, making sustainable urbanization a key policy point to administrations across the world. Here ICTs have a crucial role to play by increasing environmental efficiency across industry sectors and enabling innovations such as ITS and 'smart' water, energy and waste management.

ITU provides a platform for smart-city stakeholders – such as municipalities; academic and research institutes; non-governmental organizations

(NGOs); and ICT organizations, industry forums and consortia – to exchange knowledge in the interests of identifying the standardized frameworks needed to support the integration of ICT services in cities.

ITU-T is working to define the ICT sector's contribution to Smart Sustainable Cities by identifying the ICT systems necessary to the development of a smart city, and providing cohesion to the development and application of technologies and standards.

*For more information, also refer to [itu.int/go/ITU-T/ssc](http://itu.int/go/ITU-T/ssc)*



# Smart Water

ITU is championing a multi-stakeholder approach to the development of 'smart' water management systems; incorporating the views of irrigation, agriculture, environment and communications ministries, as well as those of the ICT industry and relevant intergovernmental and non-governmental organizations.

ITU is collecting information on national, regional and international smart water management initiatives; specifying the roles to be played by ICTs in smart water management; developing Key Performance Indicators (KPIs) to assess the impact achieved through the use of ICTs in water management systems; establishing a set of methodologies to estimate ICTs' effects on water conservation; and identifying water management ICT applications, services and standards with the potential to ensure interoperability and the benefits of economies of scale.

*For more information, also refer to [itu.int/go/ITU-T/swm](http://itu.int/go/ITU-T/swm)*

# Climate monitoring with undersea cables

Submarine telecommunications cables have significant potential as tools for climate and ocean monitoring and disaster warning. Equipping repeaters – instruments amplifying optical signals, placed an average of 100 km apart on a submarine communication cable – with climate-monitoring sensors could make the telecommunications network part of a real-time global ocean-observation network.

ITU is working alongside the World Meteorological Organization (WMO) and UNESCO's Intergovernmental Oceanographic Commission (IOC) to encourage the development of new technologies and standards needed to bring this network into existence, as well as business strategies for telecommunication companies to become active players in monitoring climate change.

- ITU/WMO/UNESCO-IOC Joint Task Force

Under the secretariat support of ITU, the Joint Task Force is studying the case for a submarine climate-monitoring network from the perspectives of Science, Engineering, Business and Law. The Task Force is working to develop a strategy and roadmap leading to the availability of submarine repeaters equipped with climate-monitoring sensors, also analyzing the potential reinvention of retired out-of-service cables as climate-monitoring infrastructure.

For more information, also refer to [itu.int/go/ITU-T/greencable](http://itu.int/go/ITU-T/greencable)





# Technology Watch

ITU-T Technology Watch reports survey the ICT environment, identifying new and emerging technologies and assessing their likely impact on future standardization work.

Technology Watch reports are written in a language accessible to non-specialists and evaluate the implications of new technologies for both developed and developing countries.

Recent reports in the series cover topics including e-health, smart cities, mobile money, spatial standards and big data.

Experts from industry, research and academia are invited to submit topic proposals and abstracts for future reports in the Technology Watch series. Please contact us at [tsbtechwatch@itu.int](mailto:tsbtechwatch@itu.int) for details and guidelines.

All reports are available free-of-charge at [itu.int/go/ITU-T/techwatch](http://itu.int/go/ITU-T/techwatch)

# Conformity and Interoperability

Conformance with international standards such as ITU-T Recommendations is one of the core principles underlying the global interoperability of ICT networks and devices.

The ITU Conformity and Interoperability (C&I) programme was initiated at the request of ITU's membership in light of the challenges faced by developing countries in improving interoperability and battling counterfeit goods.

The four-pillar C&I programme delineates ITU's C&I work into four interdependent categories:

1. conformity assessment;
2. interoperability events;
3. human resource and capacity building; and,
4. assistance in the establishment of test centres and C&I programmes in developing countries.

For more information, also refer to the ITU Conformity and Interoperability portal at [itu.int/go/ITU-T/ci](http://itu.int/go/ITU-T/ci)



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